ACTA RADIOLOGICA
EDITA PER SOCIETATES RADIOLOGICAS DANIÆ, FENNIÆ,
HELVETIÆ, HOLLANDIÆ, NORVEGIÆ ET SUECIÆ

VOL. XXXII FASC. 4 31 : X 1949 N:o 188

ANGIOGRAPHY BY POST-TRAUMATIC INTRACRANIAL HAEMORRHAGES[1]

by

Ingmar Wickbom

The clinical picture is relatively typical in certain cases of post-traumatic haemorrhage. This is especially true in the case of the epidural haematoma with the free interval and the subsequent gradually increasing intracranial pressure, the hemiparesis, and the pupil on one side dilated and non-sensitive to light. In many cases, however, the picture is obscured by a simultaneous cerebral contusion or concussion of more or less high degree. The subdural or intracerebral haematoma can be even more difficult to diagnose by purely clinical methods. A correct and prompt diagnosis is of the greatest importance, however, particularly in these cases, when a relatively simple surgical operation usually saves the patient's life. In the case of the extracerebral haemorrhage this operation is so very small (exploratory drilling), that its performance is considered by many authors to be justified for the purpose of diagnosis even with relatively little suspicion of extracerebral haemorrhage. On the whole, however, an intracerebral haemorrhage cannot be established in this way, and in order to definitely exclude the possibility of an extracerebral haemorrhage a large number of bore holes are required, since, while it is true that a haematoma has a predilection for certain sites, it may lie almost anywhere. Therefore, a method is desirable which can definitely establish or, respectively, exclude a haematoma. It is true that valuable information may be obtained from a straight skull radiograph (establishment of possible fracture or possible dislocation of intracranial calcification), but for positive diagnosis, a contrast examination

[1] Read at the meeting of the Northern Association for Medical Radiology, June 10–12, 1949; submitted for publication, July 1, 1949.

From the Roentgen Department of the Seraphimer Hospital, Stockholm, Sweden (Chief: Prof. E. LINDGREN).

is required. Of such examinations we have two different methods at our disposal at the present time, namely pneumography, that is to say examination of the ventricular system of the brain after air injection, and also cerebral angiography. The latter method is to be preferred for several reasons in these cases. A pathognomonic picture is obtained in cases of extracerebral haemorrhage whereby even very small haemorrhages may be demonstrated and definite differential diagnosis obtained between extra- and intracerebral haemorrhages. Bilateral, equal sized and symmetrically sited haematomas give no definite pneumographic changes but a typical picture with angiography. Especially in unconscious or severely injured patients angiography is usually a less trying procedure. If the percutaneous method is used, the time taken is no more or less than with pneumography.

The disadvantage in angiography is the contrast medium. The previously used Thorotrast is unsuitable as it is radioactive and is not excreted from the body and therefore may gradually cause damage specially to the liver where it is mainly collected. The water soluble iodine salt usually used at the present time (diodone, umbradil, perabrodil and others) is the same as is used in intravenous urography. It is quickly excreted from the body in normal kidney function but has a certain irritating effect upon the vessel walls, at least if higher concentrations are used. Experiments on animals carried out by Olle Olsson and Tore Broman in Lund have shown that 50 % contrast, if permitted to affect the vessel walls long enough, causes a disturbance in the blood-liquor barrier. The 35 % solution, on the other hand, produced no such effect that was demonstrable regardless of the length of the application time on a healthy brain. (Mice were the experimental animals used for the main part.) How it behaves with an injured brain is not yet known but our experience indicates that the contrast medium can probably cause a certain deterioration in an injured brain with oedema. Later examinations have shown that even 35 % contrast may occasion the same affect if the vessel wall has been previously damaged through the action of other toxic material or if the circulation is considerably slower than normally. If the presence of a severe brain contusion is suspected, the smallest possible quantity of contrast should therefore be used. More concentrated contrast than 35 % solution must never be used with acute skull injuries.

At the Serafimer Hospital the percutaneous technique is used as routine in cerebral angiography. This technique has been explicitly described in previous articles. In this connection the author will merely point out that it is important that it should not be necessary to turn the patient's head during the examination in order to take lateral pictures. Such a turning involves the risk, of course, that the needle will slip out

ig. 1. Cassette holder for angiography. he horizontal part of the cassette holder is used for frontal pictures, which are ken with vertical direction of rays. he part of the cassette holder in vertical position is used for lateral pictures, which are taken with horizontal direction of the rays. The horizontal part of the cassette holder has room for 2 cassettes, one above the other: the vertically positioned part holds 3 cassettes, which stand one behind the other. When the first picture has been taken the cassette lying nearest to the patient is withdrawn together with a lead plate, which lies between the cassettes and shields the cassettes lying below from the roentgen rays.

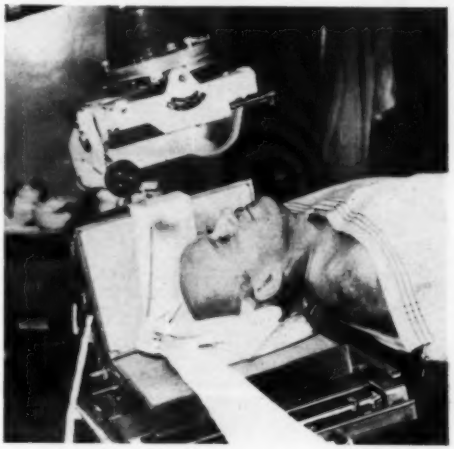


Fig. 1.

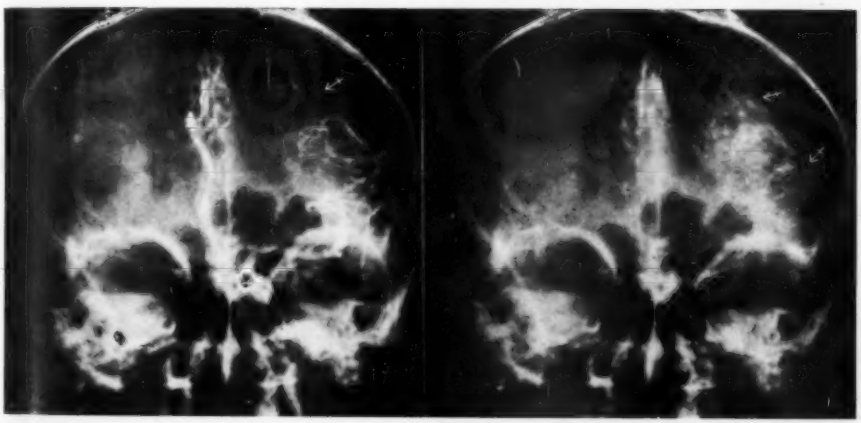


Fig. 2 a. Fig. 2 b.

Fig. 2. A typical picture of chronic subdural haematoma. Above the sylvian fissure immediately within the vault there is an area completely free from vessels which medially has an evenly rounded, convex border. The changes appear somewhat more plainly in the venous phase (the picture to the right) than in the arterial phase. The anterior cerebral artery is dislocated to the other side.

Fig. 3. A typical picture of subdural haematoma. However, in spite of the large haematoma, the anterior cerebral artery lies in the midline. This is dependent upon the presence of a haematoma of approximately the same size on the other side also.

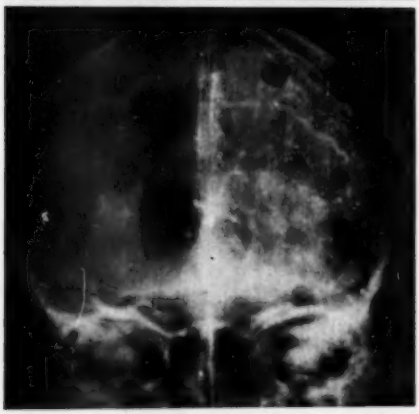


Fig. 4. A small subdural haematoma. Immediately within the vault there is a vessel-free area of a few millimetres breadth. (The haematoma is so small that it has not caused any obvious dislocation of the anterior cerebral artery.)

Fig. 5. Within the vault there is a vessel-free area a good centimetre broad. In addition there is a severe dislocation upwards and medially of the most anterior part of the middle cerebral artery which cannot be entirely explained by the extracerebral haematoma alone. At autopsy haemorrhage was found subdurally as well as in the contused temporal lobe.

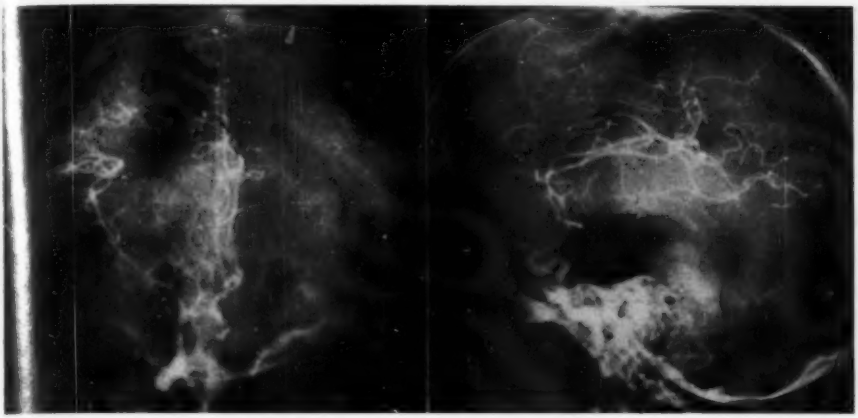


Fig. 6 a. Fig. 6 b.

Fig. 6. Within the vault there is a vessel-free area, which is only 1—2 mm broad. The middle cerebral artery is severely dislocated upwards and medially. This dislocation cannot be explained by the small extracerebral haematoma, but, on the contrary, must depend upon an intracerebral haemorrhage. At operation a subdural haematoma some millimetres thick and a large haemorrhage in the temporal lobe were found.

of the vessel and in addition makes the adjustment of straight lateral pictures practically impossible in many cases. In order to avoid this a specially built cassette holder (Fig. 1) is used at the Serafimer Hospital.

Without doubt the most usual type of intracranial haemorrhage is the subdural haematoma. This has a very characteristic appearance on angiography. One may, however, differentiate between two forms of subdural haematoma. Fig. 2 shows a typical example of the chronic form. These haematomas often appear after very slight trauma. Symptoms usually appear late and develop very slowly. Often the patient does not come for examination until several months after the trauma (which they often cannot then remember). A fairly large subdural haematoma always gives a displacement of the anterior cerebral artery. If this artery lies in the midline in spite of a large subdural haematoma, it may be inferred that a haematoma is also present on the other side (fig. 3). Even a very small haematoma may be diagnosed in this way (Fig. 4). Subdural haematoma may also appear in acute form as a consequence to severe trauma, often as a sequel to a blow against the back of the head or the other side. These haematomas are usually more basally sited, down against the temporal or lower surface on the frontal lobe, and are generally combined with a severe contusion, sometimes resulting in haemorrhage in the

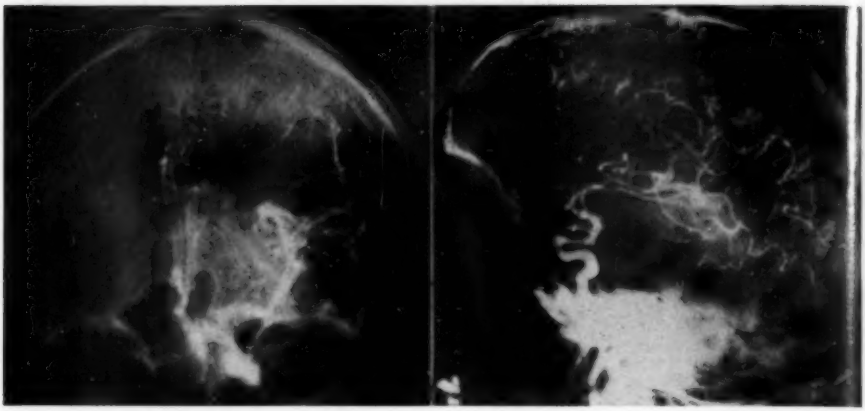


Fig. 7 a. Fig. 7 b.

Fig. 7. Within the vault there is a vessel-free area, approximately one centimetre thick, owing its occurrence to an extracerebral haemorrhage. The forwardmost part of the middle cerebral artery is dislocated medially and upwards more than that caused by the extracerebral haemorrhage. At operation both an extradural haematoma and also a contusion centre with haemorrhage in the temporal lobe were found.

surrounding brain tissue. An important mechanism for the origin of these injuries may be considered to be the following: with the blow the brain rotates in the skull and therewith strikes especially against the great wing of the sphenoid. This intracerebral haemorrhage may also be diagnosed with angiography in as much as the displacement of the middle cerebral artery is greater than that which corresponds to extracerebral haematoma (fig. 5). The size of the intra- or respectively extracerebral component varies considerably. Thus in certain cases the extracerebral haemorrhage is large and only a small centre of contusion is present in the brain, in other cases a large intracerebral haemorrhage may be found and only a small subdural haemorrhage (fig. 6). The relative size of the two components may be judged rather well with angiography, through the degree of displacement of the vessel from the vault of the skull and the respective dislocation of the middle cerebral artery.

The extra-dural haematomas for the most part give the same arteriographic picture as the subdural haematomas with a displacement of the vessels from the vault. Usually they lie above the temporal lobe and as a rule appear in consequence to a lesion of the middle meningeal artery through a fracture, which crosses this vessel. These haematomas may also be associated with a contusion or a haematoma in the temporal lobe.

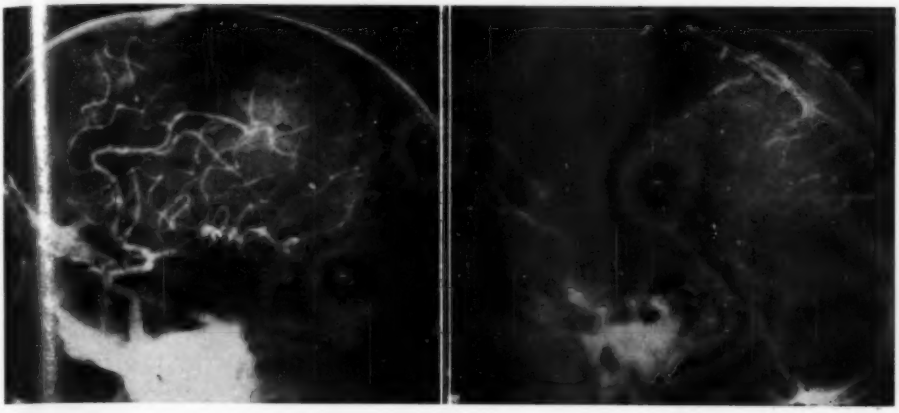


Fig. 8 a. Fig. 8 b.

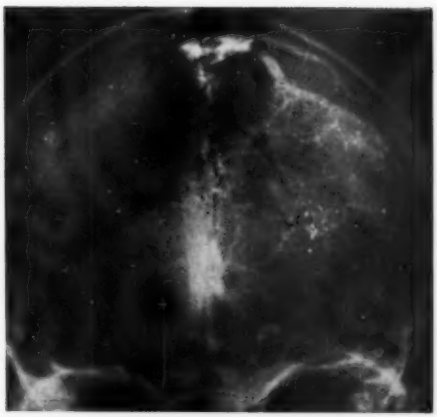


Fig. 8 c.

Fig. 8. There is a fracture which for the most part follows the sagittal suture. Under this there is a vessel-free area approximately $^1/_2$ cm thick. The haematoma must lie extradurally in this case as the superior longitudinal sinus is also dislocated from the vault. (Fig. b and c.)

Thus they cannot be distinguished radiologically from subdural haematomas (fig. 7). It is only if the haematoma lies high up and reaches the midline that it can sometimes be distinguished from a subdural haematoma because the superior longitudinal sinus is also displaced from the vault (fig. 8 a—c). Uncomplicated haematoma may also appear intracerebrally

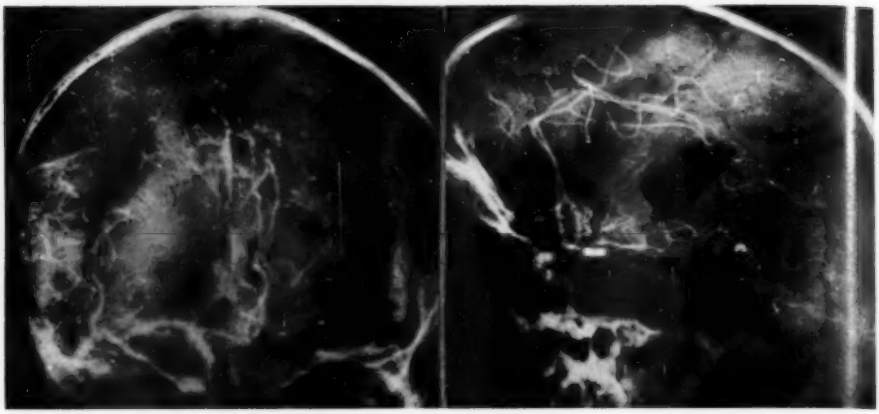


Fig. 9 a. Fig. 9 b.

Fig. 9. The anterior cerebral artery is severely dislocated and the middle cerebral artery is dislocated basally. The vessels, however, extend out everywhere to the inner side of the vault. The process must thus be intracerebral. At operation a haematoma about the size of a walnut was found in the frontal lobe immediately in front of the most anterior drill hole.

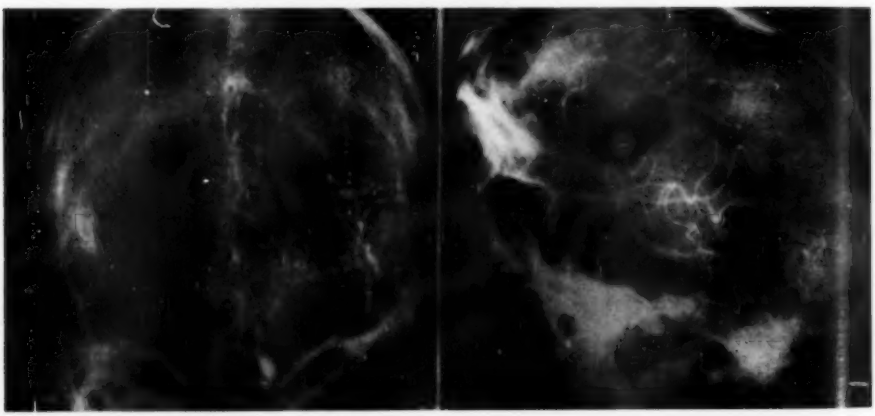


Fig. 10 a. Fig. 10 b.

Fig. 10. The anterior cerebral artery is somewhat dislocated. In the parieto-occipital region the vessels are stretched. These changes indicate a more widespread, not locally defined, expanding process. At the autopsy some days later a widespread oedema was found but no circumscribed haemorrhage in the brain.

without obvious contusion of the surrounding brain tissue. These haemtomas usually lie in the frontal or temporal lobe and at angiography show he same changes as tumours and other expanding processes with the ame localization (fig. 9 a—b). Accordingly, these haemorrhages cannot e distinguished from brain tumours by angiography alone; but if the nowledge is available that the symptoms made their first appearance n conjunction with a skull trauma, there is a considerable probability hat diagnosis may be made. A centre of contusion in the brain without aemorrhage but with oedema may, nevertheless, also dislocate the vessels s an expending process does. However, the changes are more diffuse in hese cases as with an infiltrating growing process and not so localized s with circumscribed haematoma (fig. 10 a—b).

Accordingly, in summarizing it may be said that cerebral angiography offers good possibilities for the judgment of the large anatomical changes which arise subsequent to a skull injury. In practice it is especially valuable because, in contrast to exploratory drilling, it gives information of intracerebral injuries also.

SUMMARY

Among the roentgen methods available cerebral angiography is the best diagnostic aid in intracranial haemorrhage. It has the great advantage of permitting differential diagnosis between extracerebral and intracerebral haemorrhage. It is superior to exploratory drilling inasmuch as it reveals also intracerebral haemorrhage. As a rule, the percutaneous method will prove to be an expeditious means of examining these cases.

ZUSAMMENFASSUNG

Die zerebrale Angiographie ist z. Z. diejenige Röntgenmethode, die über intrakraniale Blutungen die besten Auskünfte gibt. Vor allem hat sie den Vorzug, eine Differentialdiagnose zwischen extra- und intrazerebralen Blutungen zu erlauben. Gegenüber der Versuchsbohrung hat sie den Vorzug, auch intrazerebrale Blutungen nachweisen zu können. Mit der perkutanen Methode ist die Untersuchung zumeist schnell erledigt.

RÉSUMÉ

L'angiographie cérébrale est la méthode radiologique donnant à l'heure actuelle les meilleurs renseignements sur les hémorragies intracraniennes. Elle présente avant tout l'avantage de permettre le diagnostic différentiel entre hémorragies extra- et intracérébrales. Sur les trous de trépan explorateurs elle a la supériorité de pouvoir mettre en évidence même des hémorragies intracérébrales. Par la méthode transcutanée l'examen est, dans la règle, d'exécution rapide.

REFERENCES

1. Busch, E.: Forelæsninger over Nervesystemets Traumatologi. København 1945
2. Bull, J.: The radiological diagnosis of chronic subdural haematoma. Proceedings of the Royal Society of Medicine XXXIII (1940), 203—224.
3. Engeset, A.: Cerebral angiography with Perabrodil. Acta Radiol. Suppl. LVI, 1944
4. Engeset, A.: On roentgen examinations in head trauma. Acta Radiol. XXVI (1946), 481—494.
5. Jefferson Browder, E., Laudig, Guy H. and Robert A. Watson: Subdural haematoma. Annals of Surgery 1941, p. 170.
6. Kennedy Foster and Wortis Herman: »Acute» subdural haematoma and acute epidural hemorrhage. Surg. Gyn. and Obst. 1936, p. 732.
7. Lindgren, E.: The technique of direct (percutaneous) cerebral angiography. The British Journal of Radiology 20. 236. 326.
8. Löhr, H.: Hirnverletzungen in arteriographischer Darstellung. Zbl. f. Chir. 1936, p. 42—44.
9. Wickbom, I.: Angiography of the carotid artery. Acta Radiol. Suppl. LXXII, 1948.
10. Zehnder, M.: Die subdurale Hämatome. Zbl. f. Neurochir. 1937, p. 337.

FROM DET NORSKE RADIUMHOSPITAL, OSLO, NORWAY (HEAD: DR. MED. R. BULL ENGELSTAD)

DENTAL PROSTHESES AND INTRAORAL EPIDERMOID CARCINOMA[1]

by

Andreas Hobæk

It is a fact that the mucous membranes in most men living in a so-called civilized society, will be exposed to a number of chronic irritants of a chemical-toxical, thermal, mechanical and electro-galvanic nature. It is also well known that one, or a combination, of these irritants may, in the long run, lead to a lesion of the mucous membrane, often in the form of a precancerous condition. Although the biochemic processes that form the basis of the development of malignant tumors are still largely unknown, yet clinical experience and the results of the experimental study of cancer have given an indisputable basis for the conclusion that chronic traumata belong to the most important exogenous factors in the rise of a malignant tumor within an epithelial cell-structure. The importance of the chronic trauma is scarcely illustrated more distinctly anywhere in the organism than in the oral cavity.

VIRCHOW'S theory of chronic irritation as the cause of, or rather the stimulating exogenous factor in, the development of cancer, has been built up on the assumption that changes of a biochemical and biophysical nature arise in the life-processes of the cells. This assumption is supported by WARBURG'S observation of the altered respiratory metabolism of neoplastic tissue. Cells exposed to prolonged periods of interference with respiratory metabolism, induced by endogenous or exogenous agents, adapt themselves to the new environment and transmit this adaption to successive generations of cells. Exposed to a chronic trauma the cells will have to suffer deprivations and hardships to which epidermal cells are not normally subjected and the conditions of cell life will be fundamentally changed. According to COWDRY (1) the essential changes in the chemical composition of the epidermal cells will be characterized by a considerable reduction of important components, particularly Ca and Fe. This is evident even in the precancerous stage, but most distinctly pronounced

[1] Submitted for publication, May 12, 1949.

when the cancer is a fact. The lack of these essential components in the internal chemism of the cells makes the conditions of cell life difficul , predisposing to mutations having surviving value. Some of these mutations may constitute the malignant transformation.

For the group of intraoral epidermoid carcinomas, which will be mentioned here, it is the rule that a certain irritative factor, namely the mechanical one, comes in the foreground, as there is an indisputable causal relationship between the longlasting irritation of mucosa oris by an illfitting prosthesis and a developing cancer. In most cases of epidermoid carcinomas in the oral cavity it will be possible, as a rule, to demonstrate many of the chronic irritants mentioned in the literature, and to which more or less importance for the etiology of these cancers is attached. This is particularly the case in males, in whom in most countries epidermoid carcinomas in the oral cavity is far more frequent than in women. Although the tumor group in the present work has certain peculiar characteristics we shall not abstain from mentioning the most important forms of irritative factors in the oral cavity that have been connected with cancer development.

Thus it cannot be denied that habitual eating of particularly hot food, or highly spiced food, furthermore regular consumption of concentrated alcoholic drinks, may be a cause of the development of cancer in the upper digestive tracts. The causative relationship, however, is difficult to define, and the clinical experiences seem to indicate that the mucous membrane of the esophagus is the first to suffer. Lesions of the mucous membrane produced on electro-galvanic basis, as emphasized by LAIN (2), REINHARD & SALOMON (3) and others, by the production of weak currents between the tooth-fillings of different metals, or between the different metal components in one and the same filling, play, according to our experience, practically no part as a cause of cancer development in the oral cavity.

Also the importance of the consumption of tobacco seems to have been considerably exaggerated. So far no one has succeeded in demonstrating a specifically cancerogenic substance in tobacco, particularly not in tobacco smoke, which is the actual irritant for by far the greater number of tobacco consumers. MARTIN (4) formulates his conception of this question thus: »At any rate, it is obviously not so much the tobacco per se which is responsible in these cases, but rather the excessive indulgence and the mechanical contrivance used. — — — Although admittedly an important factor in a few individual instances, the production of cancer is certainly one of the less harmful effects of tobacco.» KIM & SUBBA-RAO'S (5) and HELMAN'S (6) observations indicate that the thermic factor in smoking is of greater importance than has formerly been assumed. An indication in the same direction is possibly given by the so-called st -

atitis nicotina (THOMA, 7). It can, however, hardly be doubted that the rect contact with the mucous membrane into which the tobacco comes hen chewed, frequently produces leukoplakias. This is distinctly demstrated by PEDERSEN (8) in his description of paradentitis marginalis xica in eskimos, caused by their peculiar way of smoking tobacco. MMERWELL (9) has demonstrated that in India, where carcinomas in e oral cavity are numerous, these tumors are found in a considerably ater number in districts where betel leaf and areca nut are chewed xed with tobacco powder, than where this is not the case. This may dicate that the tobacco is the most important factor.

The undoubtedly most frequent form of chronic intraoral irritation is represented by the so-called oral sepsis. This is a somewhat vague designation, but it refers not only to oral cavities with neglected caries, but probably more frequently, at any rate for the group of patients here concerned, to more or less advanced, chronic paradentitis, principally of the type which GOTTLIEB has called »Schmutzpyorrhoe». It is, of course, not possible to give any exact formulation of the importance of the enormously increased and multifarious bacterial flora, which is found in oral sepsis, for the mucous membrane of the oral cavity, the throat, the esophagus and the stomach, but it is a fact that epidermoid carcinomas are only rarely found in a hygienic mouth. Most cancerologists agree in emphasizing the importance of neglected oral hygiene seen in relation to the development of intraoral epidermoid carcinomas, but it is not known why this is the case. Undoubtedly the mechanical irritative factor in oral sepsis plays quite an essential part, as sharp and pointed stumps of teeth in caries and loose and tartar-covered teeth in »Schmutzpyorrhoe» are almost always found.

It must be emphasized that one may also talk of oral sepsis in toothless mouths, namely in patients carrying their prostheses both day and night, and where the hygiene is neglected. Here the combination of a chemico-toxical and a mechanical factor is quite often found. This is particularly the case in the upper jaw. For the elucidation of the importance of oral sepsis as exogenous factor in the rise of intraoral epidermoid carcinomas it is hardly possible to separate the chemico-toxical factor from the mechanical one, which is practically always present, most frequently in the form of decayed teeth, whose sharp edges represent the truly insulting factor. It is reasonable to believe that this mechanical factor is by far the most important one.

A prosthesis is an alien body, and the mucous membrane carrying it, must always be supposed to react on it. Lesions of the mucous membrane produced by prostheses have been known since the early days of prosthetic. The most frequent lesion in the oral cavity produced by prostheses and the first mentioned one, is the so-called »denture sore mouth» or

»rubber sore mouth», or, a more adequate designation, stomatitis protetica, a condition that may be produced by both well-fitting and ill-fitting prostheses. The clinical picture is well known by every dentist. A strongly red, edematous mucous membrane is found, as a rule in the palate and the processus alveolaris in the upper jaw, often of an extent corresponding exactly to the form or outline of the prosthesis. There is a desquamation of the epithelium. The subjective symptoms are most often little pronounced, so that the condition is discovered incidentally. The condition was first reported as an independent ailment by WITZEL (10) who used the designation stomatitis nudata. HENTZE (11) used the designation stomatitis traumatica, and emphasizes, like MISCH (12), LOHMANN (13) and SCHMENGLER (14), the paramount importance of the mechanical irritant produced by the prosthesis, but he also points to the probable influence of the material of the prostheses and the deficient cleaning of them. CAHN (15) and BARTELS (16) have demonstrated monilia albicans in the mucus on prostheses from patients with stomatitis protetica and maintains that thrush is mainly responsible for the changes in the mucous membrane.

Stomatitis protetica has so far not been considered a precancerous condition. This ailment of the mucous membrane will in most cases in all probability persist for years without the creation of any serious lesion. From a pathologic anatomical view the stomatitis protetica shows the picture of a regular chronic inflammation. The proliferative tendencies of the epithelium in this condition may, however, as emphasized by BRINCH (17) and WRIGHT (18), become quite distinct, and both these authors are surprised to find that cancer does not develop more often on the basis of stomatitis protetica. However, in the material which is to be reported here, there is a little group of epidermoid carcinomas in the palate, which seems to have arisen from an existing stomatitis protetica.

Lues, which particularly in French and American quarters has been mentioned as an important factor in the etiology of the intraoral epidermoid carcinomas, particularly in the case of ca. linguae, has not been demonstrated anamnestically, clinically or serologically in any case in the present material.

We know little or nothing about the endogenous factor or factors necessary for the development of cancer, which may explain why only few of the many millions of people, who are all exposed to the same intraoral irritative factors, contract their intraoral precancerosis and possibly, in due course, cancer. It is likewise not known why the development of cancer in some cases takes place relatively slowly via a more or less well defined precancerous stage such as leukoplakias, chronic ulcera and granulomas or papillomas, in other cases at a relatively quick rate in a more or less senile atrophic mucous membrane. There exists, however, a pre-

cancerous condition, namely the so-called Plummer-Vinson's Syndrome (P.V.S.), which gives occasion to catch a glimpse of the connection between the cancer-preparedness of an individual and a state of insuffiency of a certain elementary substance, namely Fe, in the organism of the person concerned. The connection is clear and is best proved by the almost specifically curative effect of this elementary substance, when it is administered in a form optimal for resorption. In this way not only is the state of insuffiency cured, but also the essential, epithelial, precancerous symptom, namely the atrophy of the mucous membrane disappears. The previously mentioned results reported by COWDRY of micro-chemical analyses of precancerous and cancerous epithelial tissue, give reason to believe that there is a connection between the heavy wastage of Fe in the cells of this tissue and the deficit of the transport-iron or enzyme-iron in P.V.S., as the condition for a defect cell respiration owing to a blockade of the intracellular respiratory enzymes (Warburg's yellow respiratory enzyme, Keilin's Cytochromes) is present in either case. It is an open question whether the same deficit is of any importance in senile atrophy of the mucous membrane.

It is AHLBOM's (19) merit to have demonstrated the importance of P.V.S. as a precancerous condition, mainly in women. AHLBOM has found in Sweden that female patients with intraoral epidermoid carcinomas in 53 % of the cases examined for anemia, but only 35 % of the total material, have a more or less distinctly developed P.V.S., and is of the opinion that the causes of the syndrome must be attributed to deficient nutrition, particularly with regard to Fe. He also emphasizes that one may expect to find similar conditions in the other Scandinavian countries. In the time after 1937, when P.V.S. has been searched for at the D.N.R. in all cases of carcinomas in the upper respiratory and digestive tracts, among 159 women with epidermoid carcinoma in cavum oris, WEYDE (21) found only 12 of them with a fully developed P.V.S. and 8 with sideropenic anemia with some epithelial symptoms. In Denmark VIDEBÆK (22) has demonstrated 6 cases of P.V.S. in a material comprising 1,313 patients with epidermoid carcinomas in the upper respiratory tracts. In Finland MUSTAKALLIO (23) characterizes P.V.S. as very rare. It is difficult to find an explanation of the striking difference between Sweden and the other Northern countries in this respect. Essential hypochrome anemia (FABER 24, 25) with sideropenia is not a rare ailment in Norway, and often with P.V.S. The ailment, however, is not so frequent as WALDENSTRÖM has demonstrated for certain parts of Sweden. It is possible that the fact that the ailment is now well known and diagnosed at an earlier stage than before, and the therapy is carried out more energetically, may play a part. Statistical information, however, shows that while in most countries women are reckoned to make 10 % of all patients with

intraoral epidermoid carcinomas, a totally different condition is found in the northern countries. In Sweden 43 % were women, in Denmark 32 %, and in Norway 30.8 %. This displacement in the percentage distribution of the epidermoid carcinomas between the two sexes may be due to the more frequent occurrence of sideropenia in the Scandinavian countries. It is probable that in coming years the effect of iron therapy will result in a decrease of the number of female patients with epidermoid carcinomas in the oral cavity, pharynx and hypopharynx.

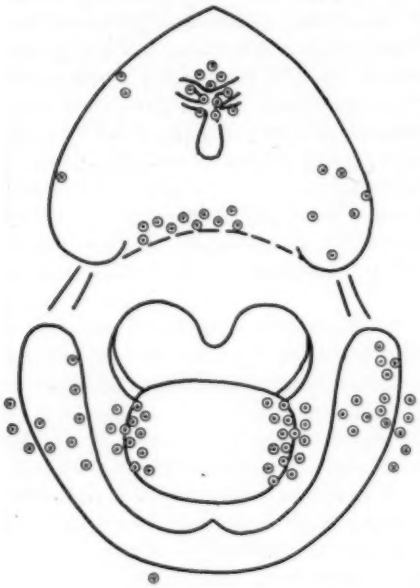


Fig. 1.

Although the above-mentioned figures indicate that the chronic sideropenic anemia plays a greater part in the development of intraoral epidermoid carcinomas than has hitherto been assumed, yet it is remarkable that, in the material to be mentioned here, among 86 cases of epidermoid carcinomas in the oral cavity due to irritation by prostheses, 61 women (70.9 %) in all are found, and in these women a fully developed P.V.S. has been found in 12 cases (20 %).

One of the most important symptoms in P.V.S. is the so-called xerostomia, as the atrophy of the mucous membrane also seems to affect the large and small salivary glands. M. FABER (26) is of the opinion that atrophy of the mucous membrane (on the tongue) is secondary in relation to the xerostomia, holding that he has observed development of »smooth tongue» also in conditions with xerostomia without contemporary sideropenia. Xerostomia leads to a quickly developing caries dentium which is the cause why these women lose their teeth at an early age, often early in the twenties, and have to carry prostheses for the rest of their lives.

At the D.N.R. we have had occasion in the last few years to observe a number of lesions of the mucous membrane caused by prostheses. Therefore the material of carcinomas of the oral cavity (comprising the period between 1932—1945) has been studied in order to elucidate the connection between the irritation by dental prostheses and the development of epidermoid carcinomas in the oral cavity.

Fig. 2.

Fig. 3.

Table No. 1

Decubital ulcers	Denture granuloma	Leukoplakia	Squamous cell carcinoma
7	24	14	86

The total material is represented in table 1. Decubital ulcera and denture granuloma (granuloma fissuratum (THOMA) (27)) are so well known that they will not be dealt with here. But it deserves to be mentioned that LINDEMANN (28) and KRANZ (29) maintain that they have observed cancer development on the basis of denture granuloma. This condition is usually seen in young people and may assume extremely monstrous forms (Fig. 2). The pathologic-anatomical picture shows a chronic inflammation with epithelial hyperplasia and, as a rule, a pronounced fibrosis. One of our cases (Fig. 3) showed several parallel-going crest-like granulomas with carcinoma development corresponding to the most orally situated one, nearest to the alveolar ridge. In this case the possibility of a direct transition into a carcinoma from a fibrotic granuloma cannot be excluded. The cancer group naturally interests us most. In all appearance it is little known that an irritation of the mucous membrane by dental prostheses over a prolonged period may lead to cancer development. Thus HILDEBRAND (30) pronounces in 1937: »It might also lie within the range of possibility to expect that a dental prosthesis might cause a cancerous growth in the mouth. As far as I know, no such cases have been reported in the literature.»

We find, however, in the literature a number of reports on epidermoid carcinomas in the oral cavity in connection with irritation by prostheses, the first one probably by PARREIDT (31) in 1889. BULL ENGELSTAD (32), KREYBERG (33), FIGI (34), QUICK (35), THOMA (36), BLOODGOOD (37)

and others have all emphasized the connection between irritation caused by prostheses and epidermoid carcinomas in the oral cavity. EWING (38) maintains: »Loose and illfitting plates frequently rub and erode the adjacent mucous membrane, and after months or years a warty or eroded cancer develops.» MARTIN (39, 40) on the other hand, finds that epidermoid carcinomas in the palate and gingiva can only rarely be seen to have any connection with faulty denture. SPRENG (41), who has written a book on lesions of the mucous membrane caused by the use of prostheses, has only observed one case of cancer.

Out of a material of 160 cases of epidermoid carcinomas in the oral cavity, BEISWANGER & STENSTROM (42) have found that in 24, at all events, of these cases, illfitting prostheses must be considered the direct cause of cancer development. By these authors illfitting prostheses have been considered the cause only when the irritation extended over a prolonged period, in most cases 10 to 20 years, never under 5. 19 of the 160 patients were women, and in 6 of these an irritation by a prosthesis had caused a development of cancer.

Table No. 2

Localization	Total number of cancer cases	Total number of denture-wearing patients	Number of cancer cases caused by irritation of dentures	Number of cancer cases caused by sharp teeth	Number of cancer patients with Plummer-Vinson's Syndrome
Ca. palati durae	55	33	21	0	0
Ca. gingivae	110	50	28	—	4
Ca. buccae	93	31	9	23	3
Ca. linguae	236	67	20	78	5
Ca. of floor of mouth	66	23	8	0	0
Total	560	204	86	101	12

The present material comprises, as mentioned above, 86 intraoral epidermoid carcinomas whose localization will be seen from table 2 and Fig. 1. The distribution according to the sex of the patients, age and average number of years during which the prostheses have been carried, will be seen from table no. 3.

Table No. 3

Number of cases	Average age at start of cancer	Average number of years dentures are worn	Upper and lower limit of time dentures are worn
Women 61	66.2 years	29 years	62—3 years
Men 25	59.6 »	7.5 »	27—1/4 »

Practically all the cancers in this material caused by the rubbing of prostheses, have been produced by plate prostheses, and, practically

without any exception, these are made of the usual brown rubber. There is little reason to assume that the caoutchouc per se has played any particular part, as without doubt the mechanic factor is the decisive one.

We have seen only in one case development of cancer in gingiva after a prolonged period of irritation by a clasp in a partial prosthesis. In one case we have also observed cancer development caused by a bridge prosthesis (buccal mucosa). As far as I have been able to find, cancer produced by bridge prostheses has previously not been reported in the literature, as changes of the mucous membrane that have been attributed to this form of prosthesis (GREVE (43), GUTH (44), WEST (45)), refer to chronic inflammation-like changes in the paradental tissue.

Discussion

It is seen from table 2 that in D.N.R.'s material comprising 560 patients with intraoral epidermoid carcinomas, 204 wore prostheses, and in 86 of these a direct connection between irritation by prosthesis and the development of a carcinoma has been demonstrated. These 86 patients have fulfilled the following conditions:

1. That the patient has worn illfitting prosthesis or prostheses for years.
2. That the prosthesis (prostheses) has irritated or chafed for a prolonged period of time.
3. That an epidermoid carcinoma has been demonstrated within the area covered by the prosthesis, or in a part of the mucous membrane that has been in immediate contact with the prosthesis.
4. That the epidermoid carcinoma has developed corresponding to the localization where the prosthesis has chafed.

We are of the opinion that the probability of a causal relationship for an epidermoid carcinoma fulfilling these conditions will be so great that a registration of the case as a carcinoma produced by irritation of a prosthesis may be justified.

As mentioned before the patients in this material show an »abnormal» distribution of sex, the women making more than 70 % of the material, while the percentage number in the D.N.R.'s total material of intraoral epidermoid carcinomas amounts to about 30 %. 12 of the women have had a distinct P.V.S., and the connection with the pronounced atrophy of the mucous membrane found in this condition, the irritation by the prosthesis and the cancer development, is quite clear. The average age of the group of females of this material is 66.1 years, of the women with P.V.S. more than 10 years lower, namely 55 years. If we assume that a patient with P.V.S. receives her first prosthesis (as a rule an upper jaw

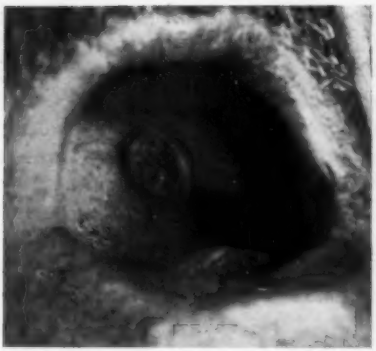


Fig. 4.

Fig. 5.

prosthesis) at the age of 25, then the time of carrying prosthesis for pat. with P.V.S. will be about 9 years shorter as the whole group of females have carried their prosthesis for 29 years. This is a relation that must certainly be considered significant.

The average age of the group of males lies at 59.6 and the average time for the carrying of the prostheses is considerably shorter than for the group of women, namely only 7.5 years, with a maximum of 27 years and a minimum of $^1/_2$ year. The fact that men receive their prostheses at a higher age than women, may possibly explain their decidedly inferior power of resistance to irritation of the mucous membrane by prostheses. It must also be emphasized that all the men in this material were moderate to heavy smokers, while none of the women used tobacco in any form.

From Fig. 1 will be seen that most of the carcinomas are found within the area of the mucous membrane that carries the prostheses, in the hard palate and on processus alveolaris. The carcinomas of the palate are distributed into two almost equal groups: one group corresponding to the highest point of the arch of the plate, and another group in the area around the posterior rim of the prostheses in the borderline between the hard and the soft palate. These tumors of the palate are almost always papillomatous (AXHAUSEN: »Zottenkrebs»). They remain low and spread over the arch of the palate. In some cases the tumor is so little prominent that the patient continues to carry his already illfitting prosthesis without having its retention particularly reduced. The epidermoid carcinomas in the palate will begin as an ulceroinfiltrative tumor (Fig. 4) far less frequently.

There is reason to believe that tumors in the top of the arch of the palate develop not infrequently on the basis of an existing stomati is

protetica that has existed for years. These tumors start as a rule as a small collection of firm, fibrous, low, papillomatous formations (Fig. 5), which spread slowly to the sides. In their initial stages these tumors will histologically show higher or lower degrees of epithelial hyperplasia with chronic inflammation in the subepithelial connective tissue, but sooner or later indisputable signs of malignancy will be found through repeated biopsies. In this material 4 tumors with this localization had been produced by suction chamber on the prostheses (Fig. 6). In these cases it is not necessary to assume the probability of a causal connection, the form of the tumor giving the direct proof of the relationship between the irritation and the cancer development.

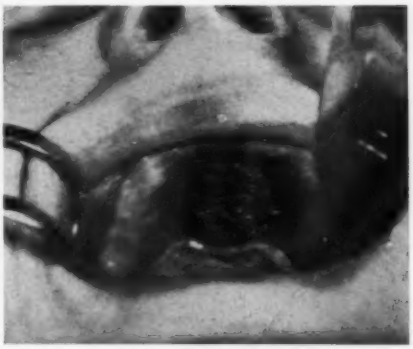


Fig. 6.

Also the tumor group around the posterior rim of the prosthesis is papillomatous in shape, partly with a tendency to the formation of large papillomas. The cause why epidermoid carcinomas in the palate most often occur with the two above-mentioned localizations, is partly to be attributed to the gradual atrophy of all the prostheses-carrying structures, mucous membrane, submucous glandular and fat tissues, and bone. With increasing atrophy the pressure points of the prosthesis of the upper jaw in chewing, swallowing, talking etc. will be in the very top of the palate, at its posterior borderline and in the bucco-gingival sulcus.

Table 2 shows that less than half of the 110 patients with ca. gingivae had carried prostheses. Thus we see that most of the epidermoid carcinomas arise in gingiva propria in patients who have still their teeth more or less intact. We have only been able to demonstrate in 3 of these cases that the malignant tumor started in an area of the processus alveolaris that was devoid of teeth and where the patient had not exposed the mucous membrane to the pressure of any form of prosthesis. In all probability most of the representatives of this group of gingival carcinomas have arisen in the gingiva itself, around decayed teeth, or in a gingiva that is the site of a chronic »Schmutzpyorrhoe». AXHAUSEN (46) mentions a type of tumor which he designates »primären Knochenkarzinome» in the processus alveolaris, arisen in jaws with wellkept teeth and sound gingival tissue. Also at the D.N.R. some carcinomas of that type have been seen. In these cases tumor starts in the very processus alveolaris, probably in isolated epithelial remnants (débris epithéliaux Mallasséz).

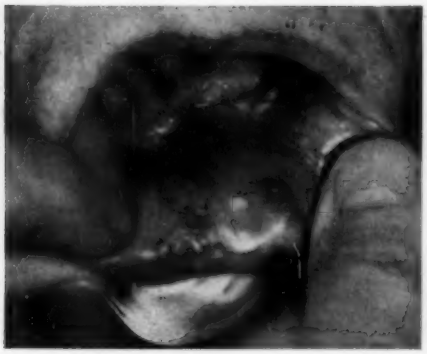


Fig. 7.

Fig. 8.

Gingival carcinomas produced by the irritation of prostheses (Figs. 7 and 8) constitute the largest group in this material. As might be expected they are found almost twice as frequently in the lower jaw as in the upper jaw, which, again, is connected with the far greater difficulties of retention of the prostheses in the lower jaw. As these carcinomas do not arise in any gingiva propria, but in the pale, thin and tight mucous membrane covering the atrophied processus alveolaris, the designation: cancer processus alveolaris would have been much more correct. From Fig. 1 will be seen that by far the greater number of carcinomas of this type have developed in the molar region.

All the cases of cancer buccae and cancer regionis sublingualis in this material are undoubtedly due to chafing of the buccal, respectively lingual, wing of the prostheses of the lower jaw. From table no. 2 will be seen that sharp, decayed teeth are more frequently the cause of ca. buccae than irritation caused by prostheses, and this is still more the case with ca. linguae. All the cases of ca. linguae in this material have, of course, been localized to the lateral borders of the tongue usually in the molar area. In by far the greater number of cases the lingual surface of the mandibular denture is the irritative factor (Fig. 9). Here undoubtedly peculiar anatomic relations play a part, as a narrow lower jaw or a broad tongue will increase the possibilities of irritation. From Fig. 10 it will be seen that the irritation which the completely smooth lingual surface of a mandibular prosthesis exercises, may produce a rather pronounced atrophy of the mucous membrane of the tongue.

Cancer development via leukoplakia has been demonstrated in 14 out of the 86 epidermoid carcinomas in this material, and the leukoplakias have been found most frequently localized to gingiva both in the cancer cases and in the uncomplicated leukoplakias. We must also assume that

Fig. 9.

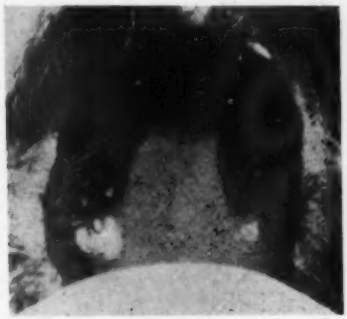


Fig. 10.

a number of palatal carcinomas develop via a precancerous stage in the form of a stomatitis protetica, but most of the tumors in this material seem to have developed without any demonstrable welldefined precancerous condition. MARTIN says: »If the patient wore any form of denture, it would necessarily become illfitting in the presence of an underlying gingival tumor, and in such cases a direct causal relationship, even though erroneous, would always be assumed.» Exactly for the sake of elucidating this point we have tried to ascertain how long the irritation of the prosthesis has been present corresponding to the localization where later the tumor developed, before the first signs of the tumor could be demonstrated. This has been possible in most cases although the statements of time have been somewhat vague. To be on the safe side we have excluded all the cases where the irritation has not lasted above half a year. In some cases the irritation by the prostheses in the top of the arch of the palate has given only slight irritations so that the pat. has not reacted until tumor development had already begun. But in these cases the importance of the irritation by the prosthesis for the formation of cancer has been so evident that the cases have been included in the material.

In the cases where the cancer development takes place without any precancerous stage, the tumor development at the irritation point seems to take place very rapidly. The time of starting is, as a rule, characterized by increased symptoms in the form of greater pains from the irritation area. The process often seems to begin as an ulceration that is no decubitus but from the beginning an ulceroinfiltrative tumor.

Most of the epidermoid carcinomas in this material have arisen in elderly people, and also in the patients without any signs of P.V.S., the mucous membrane has shown decidedly atrophic changes. The atrophy is certainly conditioned here essentially by an incipient senium, and the

atrophic changes are still more accentuated by the irritation of the prosthesis. In the analysis of the material presented here, it is, however, of importance to emphasize that by far the greater number of the patients come from rural districts where it has always been difficult to obtain dental treatment, not only at the time when the prostheses were made, but where also in our days long distances and bad communications prevent regular control, rebasing or necessary new construction of prostheses. Thus most of the patients have used the same prosthesis or prostheses for years, often for several decades. Many have also used their prostheses day and night without removing them, and the cleaning has been highly neglected. It must be assumed that the amount of irritation represented by an illfitting prosthesis for the above-mentioned reasons, will be considerably increased in most patients. Despite the number of dental prostheses in use (WEISSENFLUH (47), PEDERSEN (48)) cancer development on the basis of irritation by prostheses will certainly be utterly infrequent in properly treated and controlled patients. BEISWANGER'S and STENSTROM'S work, however, shows that also in districts with an easy access to dental treatment, epidermoid carcinomas in the oral cavity may also arise because of irritation by prostheses.

By strict and frequent controls of all persons using prostheses, particularly those above 50, and patients suffering from P.V.S., and the instruction of scrupulous oral hygiene, and careful watching of the prosthesis-supporting mucous membrane, it must be considered probable that carcinomas produced by chafing of dentures will disappear.

SUMMARY

From 1932 to 1945 560 intraoral epidermoid carcinomas were treated at the Norwegian Radium Hospital. By the study of this tumor material it has been possible to demonstrate a causal connection between irritation caused by prostheses and cancer development in 86 of these cases. 61 (70 %) were women. 12 of them (20 %) had a marked Plummer-Vinson's Syndrome.

The author deals briefly with the most usual factors in the development of epidermoid carcinomas in the oral cavity and points out the importance of the atrophy of the mucous membrane of the mouth in sideropenic anemia with Plummer-Vinson's Syndrome and the senile atrophy of the mucous membrane, and also emphasizes these conditions as important factors in the development of carcinomas caused by chafing of prostheses. The majority of these carcinomas develop without any demonstrable precancerous initial stage, but a number of leukoplakias have been observed and in some cases stomatitis protetica in the palate must be considered a precancerous condition. Different localizations of the tumors and characteristic features are briefly dealt with.

ZUSAMMENFASSUNG

Von 1932 bis 1945 wurden in der Norwegischen Radiumklinik 560 Fälle von Epidermoidkrebs der Mundhöhle behandelt. Das Studium dieses Tumormaterials ermöglichte

bei 86 dieser Fälle den Nachweis eines kausalen Zusammenhanges zwischen durch Prothesen verursachten Reizzuständen und Krebsentwicklung. 61 (70 %) waren Frauen. 12 von ihnen (20 %) wiesen ein ausgesprochenes Plummer-Vinson'sches Syndrom auf.

Verf. bespricht kurz die gewöhnlichsten Faktoren bei der Entwicklung von Epidermoidkrebs der Mundhöhle und macht auf die Bedeutung der Atrophie der Mundhöhlenschleimhaut bei sideropenischer Anämie mit Plummer-Vinson'schem Syndrom aufmerksam sowie der senilen Atrophie der Schleimhaut und betont ferner diese Zustände als wichtige Faktoren in der Entwicklung von durch scheuernde Prothesen verursachten Krebsen. Die Mehrzahl dieser Krebse kommt ohne nachweisbares präkanzeröses Initialstadium zur Entwicklung, doch ist immerhin eine Anzahl von Leukoplakiefällen beobachtet worden, und in gewissen Fällen ist eine Stomatitis prothetica des Gaumens als präkanzeröser Zustand anzusehen. Die verschiedenen Lokalisationen und charakteristischen Züge der Tumoren werden kurz besprochen.

RÉSUMÉ

De 1932 à 1945 560 carcinomes épidermoïdes intrabuccaux furent traités à l'Hôpital Norvégien du Radium. Par l'étude de ce matériel de tumeurs il a été possible de mettre en évidence un rapport de cause à effet entre l'irritation due à des prothèses et le développement du cancer dans 86 de ces cas. 61 (70 %) d'entre eux concernaient des femmes. 12 (20%) présentaient de façon marquée un syndrome de Plummer-Vinson.

L'auteur s'occupe brièvement des facteurs les plus courants du développement des carcinomes epidermoïdes de la cavité buccale, met en vedette l'importance de l'atrophie de la muqueuse de la bouche dans l'anémie ferriprive avec syndrome de Plummer-Vinson et atrophie sénile de la membrane muqueuse, et souligne aussi le rôle considérable que jouent ces états dans l'apparition des cancers causés par le frottement des prothèses. La majorité de ces carcinomes se développent sans qu'on puisse démontrer l'existence d'aucun stade précancéreux initial, mais nombre de leucoplasies ont été observées, et dans certains cas une stomatite par prothèse, du palais, doit être considérée comme un état précancéreux. Les divers localisations des tumeurs et leurs aspects caractéristiques sont succinctement traités.

REFERENCES

1. E. W. Cowdry: Epidermal carciogenesis. J. A. M. A. 135. 408. 1947.
2. E. S. Lain: Electrogalvanic lesions of the oral cavity. J. A. M. A. 100. 717. 1933.
3. H. C. Reinhard & H. A. Solomon: Electrical currents from dental material as etiologic factor in oral cancer. Am. J. Cancer 22. 606. 1934.
4. H. Martin: Cancer of the lips (1). Annals of Surg. 114. 226. 1941.
5. McKim & K. V. Rubra Rhao: Cited by L. V. Ackermann & A. J. del Ragato: Cancer. The C. V. Mosby Company, St. Louis 1947 (p. 308).
6. J. Helmann: Epithelioma of the mouth in Hottentot Women. South African Med. J. 12. 17. 1938.
7. K. Thoma: Oral Pathology. The C. V. Mosby Co. St. Louis 1944.
8. P. O. Pedersen: Meddelelser om Odontologiske Undersøgelser i Grønland. III. Tandlægebladet 42. 397. 1938. (English Summary.)
9. T. H. Sommerwell: Recent advances in the treatment of cancer of the mouth and jaws. Brit. J. Surg. 32. 35. 1944.
10. A. Witzel: Cited by Hentze and Lohmann.
11. A. Hentze: Die Entzündungen der Mundschleimhaut. In Julius Misch: Die Fortschritte der Zahnheilkunde. Vol. 2. p. 600. Leipzig, G. Thieme, 1926.

12. J. Misch: Lehrbuch der Grenzgebiete der Medizin und Zahnheilkunde. p. 43. Leipzig, F. C. W. Vogel, 1922.
13. A. Lohmann: Über Erkrankungen der Gaumenschleimhaut unter Kautschukplatten. D. Zahnärztl. Wochenschr. 8. 157. 1908.
14. J. Schmengler: Mundhygiene und Zahnersatz mit besonderer Berücksichtigung der Kautschukprothese. Ergebn. der Zahnheilk. 1922. Vol. II. p. 329.
15. L. R. Cahn: Denture Sore Mouth. Ann. Dent. 3. 33. 1936.
16. H. A. Bartels: Significance of yeastlike organisms in denture sore mouth. Am. J. Orthod. & Oral Surg. 23. 90. 1937.
17. O. Brinch: Histologische Untersuchungen über pathologisch-anatomische Veränderungen im Gaumengewebe Prothesetragender Patienten. V. Jahrschr. f. Zahnheilk. 48. 120. 1932.
18. W. H. Wright: The importance of tissue changes under artificial Dentures. J. A. D. A. 16. 1027. 1929.
19. H. E. Ahlbom: Prädisponierende Faktoren für Plattenepithelkarzinom in Mund, Hals und Speiseröhre. Acta Radiol. 18. 163. 1937.
20. — Om anæmi och dysfagi (Plummer-Vinsons Syndrom) i sjukhistorien hos kvinnor med cancer i mun, svalg och matstrupe. Nord. Med. Tidsskr. 11. 171. 1936.
21. R. Weyde: Plummer-Vinsonsyndromet, sideropen anæmi og platepitelkarcinomer i munnhule, svelg og ösofagus hos kvinner. Tidsskr. f. d. Norske Lægeforening. 67. 194. 1947.
22. Aa. Videbaek: Om multiple Tumorer i de øvre Spiseveje. Nordisk Medicin. 28. 2486. 1945.
23. S. Mustakallio: Über das Larynx- und Hypopharynx-karzinom. Acta Radiol. 25. 13. 1944.
24. K. Faber: Achylia gastrica mit Anämie. Med. Klin. 5. 1310. 1909.
25. K. Faber, C. Mermod, A. L. Glason & R. P. Wilkins: Microcytic, hypochromic (Iron deficiency) Anæmia in Childhood. J. Pediatr. 7. 435. 1935.
26. M. Faber: The smooth tongue. Acta Med. Scand. 121. 179. 1945.
27. K. H. Thoma: Oral Pathology. The C. V. Mosby Co. St. Louis 1944.
28. A. Lindemann: Über frühzeitige Erkennung und Behandlung des Krebses und der Krebsähnlichen Gebilde des Mundes, der Kiefer und des Gesichts. Z. Stomat. 35. 145. 1937.
29. P. P. Kranz: Klinische Zahnheilkunde und ihre Grenzgebiete. Munich-Berlin. J. F. Lehmann 1943. p. 418.
30. G. Y. Hildebrand: Studies in Dental Prosthetics. Supplement to Swedish Dent. Journ. 30. 257. 1937.
31. Parreidt: D. Monatschr. f. Zahnheilk. 1889. Cited by Schmengler.
32. R. Bull Engelstad: Maligne svulster i munnhulen og dens nermeste naboskap. Den Norske Tannlægeforenings Tidende. 50. 119. 1940.
33. L. Kreyberg: Et tilfelle av »gebisskreft». Den Norske Tannlægeforenings Tidende 36. 97. 1926.
34. F. A. Figi: Malignant diseases of the mouth. J. A. D. A. 26. 1979. 1939.
35. D. Quick: Levkoplakia and allied Mouth conditions. Canad. D. A. 40. 234. 1939.
36. K. H. Thoma: Clinical Pathology of the Jaws. p. 346. London. Ballière, Tindale & Cox. 1934.
37. J. C. Bloodgood: Summary of etiologic factors and resultant lesions in cancer of the oral cavity. J. A. D. A. 19. 1738. 1932.
38. J. Ewing: Causes and diagnosis of intraoral carcinoma. Bull. Chicago. D. Soc. 9. 6. 1929.
39. H. Martin: Tumours of the Palate. Arch. Surg. 44. 599. 1942.
40. — Cancer of the gums. Am. J. Surg. 54. 2. 1941.

41. M. Spreng: Die Prothese und die lebenden Gewebe. Basel, Apollonia Verlag. 1945.
42. E. H. Beiswanger & K. W. Stenstrom: Carcinoma of the cheek, alveolar process, floor of mouth and palate. Radiology. 44. 273. 1945.
43. K. Greve: Die Einwirkung von Brückenbügeln auf die Kieferschleimhaut. Korresp. Bl. f. Zahnärzte. 51. 312. 1927.
44. A. Guth: Veränderungen der Schleimhaut unter Brückenkörpern. Rev. Mens. Suisse d'Odontologie 46. 495. 1936.
45. G. Vest: Histologische Untersuchungen über die Reaktion der Schleimhaut auf die Dauerberührung mit Metallbrückenglieder. Rev. Mens. Suisse d'Odontologie 43. 291. 1933.
46. G. Axhausen: Die allgemeine Chirurgie in der Zahn-, Mund- und Kiefer-Heilkunde. Munich. J. F. Lehmann. 1943.
47. H. V. Weissenfluh. Prothesenhygiene. Rev. Mens. Suisse d'Odontologie. 55. 803. 1945.
48. P. O. Pedersen: Protesefrekvensen hos Kvindelige Hospitalspatienter. Tandlægebladet. 47. 437. 1943.

FROM THE ROENTGEN DEPARTMENT OF THE SERAFIMER HOSPITAL, STOCKHOLM, SWEDEN
(HEAD: PROFESSOR ERIK LINDGREN)

A DESIGN FOR AN ELECTROKYMOGRAPH AND SOME FUNDAMENTAL CONSIDERATIONS ON THE ELECTROKYMOGRAM[1]

by

Ture Andersson, Med. Lic.

Attempts have been made for a long time to record the movements of the heart electrically by means of a tube sensitive to radiations, but it is only in recent years that much success has been attained. In 1945, BOONE and HENNY described the first apparatus based on the photo multiplier tube, with which the pulsations of the heart could be recorded in a satisfactory manner. Improvements on this electrokymograph were published by the same authors in conjunction with CHAMBERLAIN in 1947, and in the following year, LUISADA, FLEISCHNER and RAPPAPORT gave details of an apparatus based on the above, but modified in certain respects.

It is desirable that an apparatus of this kind should exactly reproduce the movements of the contour of the heart in every detail. Among the difficulties to be overcome before this result is obtained, interfering frequencies are the most serious. For this reason, the problem of filtres plays an important part in the construction of an electrokymograph. It was also, principally, an improved filtre system which distinguished BOONE, HENNY and CHAMBERLAIN's later apparatus from the original, and it was likewise mainly in this respect that LUISADA modified his electrokymograph. Since the frequencies to be filtered out extend down to as far as 50 cycles per second (in America 60 per sec.), the filtre comes very near to affecting the frequency band which it is desirable to record. Certain phases of the heart cycle must in fact be considered to take place in about 0.04—0.08 secs. (WIGGERS). LUISADA touches on this problem, but none of the authors have given any information as to the degree of

[1] Submitted for publication, July 5, 1949.

After submission of this paper for publication, »Some Aspects of the Use of Electrokymography in Cardiac Investigation» by B. Engström et al. appeared in the Acta Rad. 31: 435. It could, therefore, not be referred to in the author's article.

influence their filtres exercise on the form and structure of the electrokymograph curve. The ideal condition, where all interference frequencies are filtered out and all the desirable ones are reproduced entirely unaffected, cannot be attained, but we must content ourselves with a compromise, and the way in which this can best be reached is to a great extent decisive for the usefulness of the electrokymograph in diagnostics.

At the Serafimer Hospital, since 1937, trials have been going on with equipments of the electrokymograph type, in which different types of tubes and various designs have been tested. Promising results were first obtained with the Geiger-Müller-tube (HJELMARE 1946). When photomultiplier tubes of modern type were tried (931 A), it became quickly evident that these were more suitable for the purpose. In 1948, one of us published a short description of the first definite electrokymograph of this type. Its design had, however, certain weak points. Thus, its time constant was relatively high, so that the curve was more rounded-off than was desirable. Experiments were, therefore, continued with a view to finding a better design, and this was finally attained in the autumn of 1948.[1]

Of the interferences which have to be overcome on such an apparatus, the most important are:

1) Irregularities in the functioning of the photo multiplier tube.
2) Mains fluctuations.
3) Ripple frequencies, caused by the H. T. rectifier of the roentgen apparatus, which generally rise to double the mains frequency.
4) Disturbances of mains frequency from the mains supply.

In order to eliminate these factors, the following measures were taken.

We have found that certain irregularities in the functioning of the photo multiplier tube arise at higher voltages (1,000 volts and over). We, therefore, exceed 800 volts only in exceptional cases, because at this voltage no disturbances of this kind worthy of note arise.

The voltage on the 50 cycle mains varies by several per cent when other loads in the hospital are switched on or off, causing considerable variations of intensity in the roentgen apparatus itself. For this reason, very inconvenient jumps are produced in the course of the recorded curve. A voltage stabiliser, connected between the mains and the roentgen apparatus, remove these disturbances for the most part.

The roentgen apparatus which we have chiefly made use of is provided with a 4 valve H. T. rectifier, which therefore produces a ripple frequency of twice that of the mains (100 p/s). Filtering is therefore necessary. We have used two H. T. oil condensers, each of 0.1 μF, connected

[1] The apparatus is constructed by civil engineer H. Fredholm.

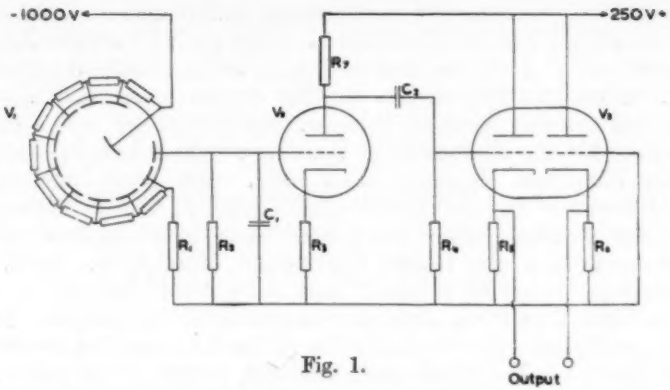


Fig. 1.

between the earth and the two outer poles on the H. T. rectifier. In conjunction with the capacity of the cables they produce a satisfactory smoothing of the ripple.

Much more difficult to overcome were interferences of mains frequency (50 p/s), which interfered not only with the electrokymogram but also with the electrocardiogram. Attempts to filtre out these frequencies in the electrokymograph amplifier certainly succeeded, but only at the cost of the amplifier's time constant. The filtre in fact caused such an increase in the latter that the higher frequencies in the electrokymogram were substantially weakened or altogether suppressed, so that the result was a recording poor in details. We have therefore tried a compensation method which has given very good results. Further improvements along these lines are expected to be in operation shortly.

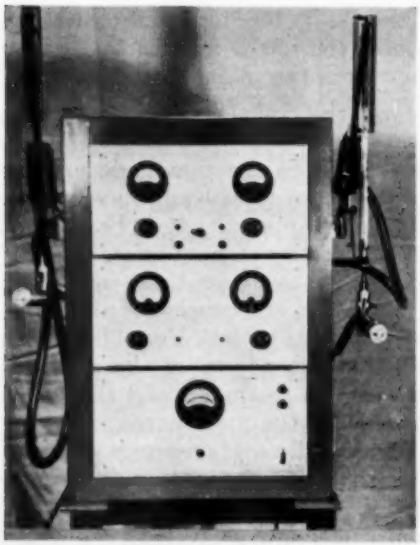


Fig. 2.

Our apparatus is arranged for two channels and therefore permits of the simultaneous recording of the movements at two not too adjacent points on the border of the heart. Fig. 1 shows a diagram of one channel. The photo multi-

plier tube V_1 is connected by a screened cable direct to an amplifier tube V_2 with weak negative feedback. $R_2 \cdot C_1$ suppress any higher frequencies that may arise. V_2 is resistance-capacity coupled to one electrode system in the double triode V_3. The time constant for the coupling elements reaches 4—5 seconds, which allows undistorted transmission of the lowest heart frequencies. The cathodes of the double triode are connected to earth via two equal resistances. The recording galvanometer is connected between the cathodes where the output impedance corresponds fairly well to the resistance of the galvanometer. At rest, the current in the galvanometer is zero since both the cathodes are at the same potential.

As has already been mentioned, the 50 cycle interferences were very troublesome. We were able to compensate them quite satisfactorily by feeding a 50 cycle A. C. voltage to the vacant grid in the double triode V_3, this voltage having the same amplitude and phase as the interfering voltage arising on the signal grid. The interfering voltages developed over R_5 and R_6 then cancel out each other in the galvanometer circuit. This device is not indicated in the diagram.

Fig. 2 shows the apparatus from the front. Both the photo multiplier tubes are cased in lead tubes with slits, 20 × 4 mm, covered with pieces of fluorescent screen (Patterson B 2). The resistances of the voltage divider are soldered directly to the soldering tags of the tube-sockets and embedded in paraffin wax. These units are inserted in 35 mm Al tubing, supported by folding arms, which allow for the adjustment of the tube to any desired position in range of the arms. Flexible metal tubes containing the necessary leads connect the photo multiplier tubes to the amplifiers provided for them.

These are situated in the upper unit (fig. 2). The middle portion contains the H. T. rectifier with automatic voltage stabiliser and devices for the manual adjustment of the voltage levels. The lower portion is taken up by a stabilised anode voltage supply. Mains voltage variations of ± 15 % have no noticeable effect on the output voltages from the two rectifiers.

For the recording, we use an ordinary electrocardiograph (Elmqvist) with four galvanometers, of which two can be connected directly to the two channels of the electrokymograph amplifier. The two others are used for making an electrocardiogram. A combination of electrokymogram, ECG and sphygmogram can also be simultaneously carried out on the ECG apparatus, and this is the procedure that we mostly employ now.

If, for example, the ECG is to be used as a time mark for the kymogram, it is important to know whether any relative time-lag exists between the two recordings. In order to determine this, we have con-

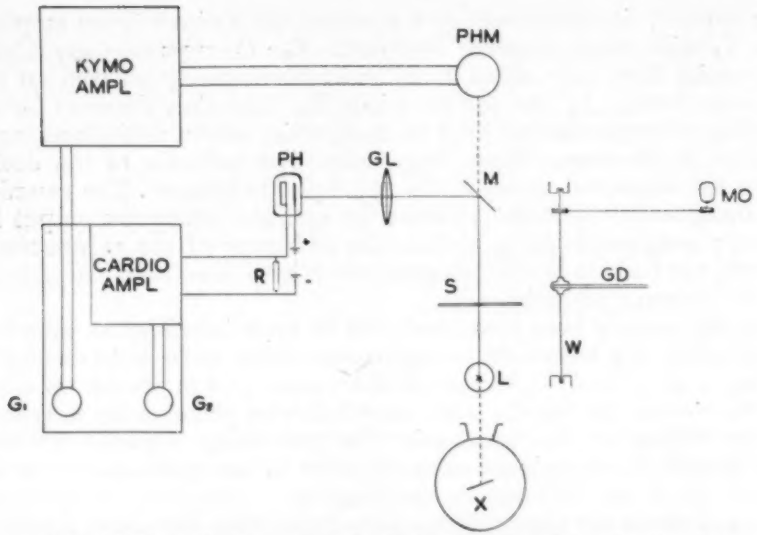


Fig. 3. Schematic diagram of the device for determining the time-lag. X = Roentgen tube. L = flash lamp bulb. S = slit in the lead diaphragm. M = mirror. Ph = photocell. GL = convex lens. MO = motor driving the semicircular disc GD. PHM = Photomultiplier tube. See further in text.

Fig. 4. The same device as diagrammatically set out in fig. 3. (Same designations as in fig. 3.)

structed an auxiliary apparatus of which fig. 3 shows the principle and fig. 4 the construction.

X is the roentgen tube, L a flash lamp bulb. In a 1 mm lead plate,

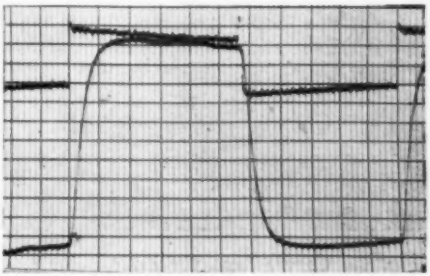


Fig. 5. Curves taken with the device in figs. 3 and 4. Above, the »light curve» from the photocell (PH). Below, the »roentgen curve» from the electrokymograph. Simultaneous deviations on both curves for simultaneous changes of light and roentgen ray intensity.

a small slit (1 mm) is provided, S, above which is placed a small mirror M which reflects the light from L on to the photo tube PH via the convex lens GL. Changes in the intensity of the light produce variations of voltage over the resistance R which are directly fed to the amplifier of the electrocardiograph channel.

The roentgen rays are not reflected by the mirror M, but pass through it and fall on the photo multiplier tube PHM which operates its accompanying galvanometer via its ordinary amplifier.

A shaft W, carrying a semicircular glass disc GD, is driven by the motor MO at a speed of about 1 revolution per second, which roughly corresponds to the normal heart frequency. When the glass disc passes the radially placed slit S, a sudden increase in the absorption of both light and roentgen rays is produced, thereby causing a sudden deflection on both galvanometers. At the same moment as the revolving glass disc leaves the slit S, the galvanometer deflection disappears as quickly as it came. In fig. 4, which shows the construction of the device, the designations are the same as in fig. 3. From fig. 5, which gives the reproduction of a recording, it may be clearly seen that both courses are simultaneous, and that consequently no relative time-lag exists between the two curves. One difference, however, may be noticed. While the »light-curve» is rectangular with steep up and downward branches, the »roentgen-curve» shows a certain slope in the corresponding parts, caused by the time-constant introduced by the interference filtre. From these recordings, the time-constant can be fixed with great accuracy at 0.04 seconds. This simple method of determining the time-constant has been of great use during the work of construction.

Even the highest heart frequencies (protodiastole about 0.04 secs.) should be reproduced with only slight distortion with this time-constant. However, the time-constant can be reduced by half without any interfering ripple arising except under heavy load. Even in such cases it is moreover expected that the time-constant may be reduced after further development of the above-mentioned method of compensation.

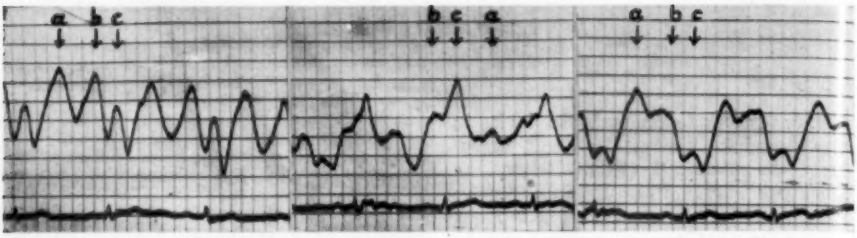


Fig. 6. Curves from the same point on the right auricle contour in a patient with a healthy heart.

1) With the patient holding his breath in the ordinary way.
2) During Valsalva's experiment.
3) During Müller's experiment.

The ventricle components are more prominent and the auricle components less marked during Valsalva's experiment. During Müller's experiment, on the contrary, the auricle components predominate.

a = opening of the atrio-ventricular valves. b = auricular systole. c = beginning of the ventricular expelling phase.

The patients are examined either prone or in the sitting position. The region of the heart to be examined is delineated with the primary shutter during irradiation, and the photo tube in its cover is placed over the contour so that the centre ray passes through the inspection slit. This must be placed at right angles to the tangent to the portion of the heart's contour to be examined, and be covered by the heart to about half its extent. The movements of the contour are recorded during several heart cycles when the amplitude of the galvanometer deflection has been adjusted to a suitable size. This is generally done by regulating the output from the amplifier to the galvanometer or by adjusting the intensity of the roentgen rays, and only in exceptional cases by increasing the voltage of the photo tube.

The usual voltages for the roentgen tube are 55—75 kV and 2—4 mA. More than 5 mA are practically never used.

In general, we make the patient hold the breath while the curve is being recorded. It may, however, be useful to take curves during breathing as well, because the movements of the heart have a somewhat different character during inspiration and expiration, and specially because certain patients involuntarily make Valsalva's experiment when they hold their breath. In both Valsalva's and Müller's experiments the character of the kymogram changes, depending on the effect of the changed conditions of pressure in the thorax on the heart (fig. 6). The breathing

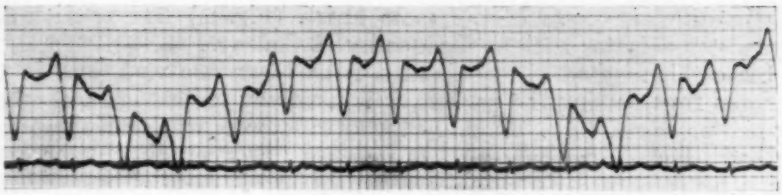


Fig. 7. Electrokymogram recorded during breathing. The longish, flat waves indicate the breathing movements.

movements may be seen as regular waves of low frequency on which the electrokymogram is superimposed (fig. 7).

The electrokymogram has been described above as an expression of the movements of the heart's contours. This, however, is not the whole of the facts, because the variations in density, which depend on changes of volume and shape in that part of the heart covered by the slit, also make a part of the curve which is thus a combination of the movements of the contour and a densogram. The former predominate, but the proportion between the two factors varies somewhat in different hearts and

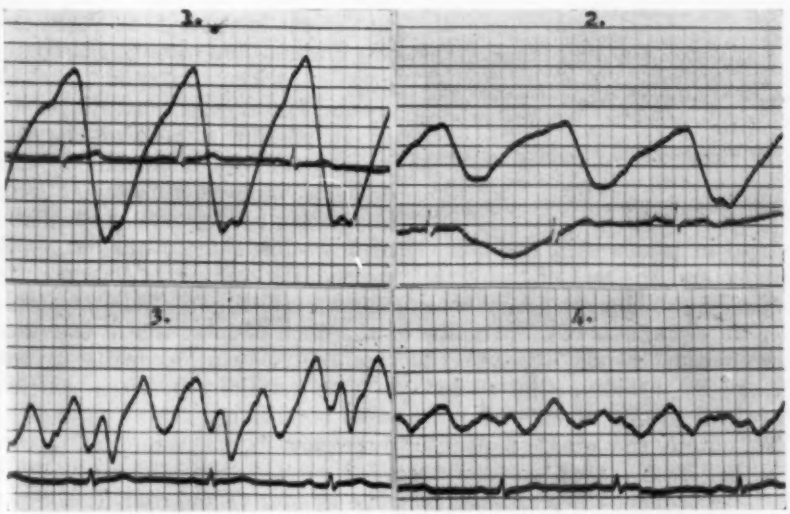


Fig. 8. Electrokymogram from the left ventricle (1) and from the right auricle (3) recorded with half the inspection slit over the heart contour. (2) and (4) are taken in the same place and with the same roentgen ray intensity and amplification as (1) and (3) respectively, but with the slit right over the heart contour.

also in different parts of the same heart. (Fig. 8.) The relation also depends on a factor such as the quality of the rays.

Since this method of examination is based on the variations in the roentgen rays passing the patient, it is naturally useless in cases where morbid processes have diminished the difference in density between the heart and its surroundings. It may thus be very difficult or quite impossible to obtain readable electrokymograms in cases of heart disease accompanied by pronounced stasis of the lungs, especially as the pulsations in such cases are often small.

Synchronously with the electrokymogram, a comparative curve is taken for time determination. CHAMBERLAIN uses a carotid sphygmogram taken with a pneumatic system, while LUISADA takes a synchronous phonocardiogram. We, like KJELLBERG, previously only took an electrocardiogram, but now we have changed over to simultaneous recording of ECG and carotid sphygmogram (Fig. 9).

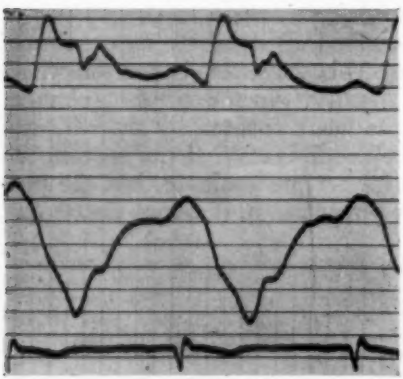


Fig. 9. Simultaneous recording of carotid sphygmogram, electrokymogram and electrocardiogram. (From above.)

Against ECG CHAMBERLAIN remarks »that the time relationships of various landmarks on the electrocardiogram are not precisely correlated with the dynamic heart cycle». On the electrocardiogram, it is not possible to read off the exact time point for a certain dynamic moment in the action of the heart. According to WIGGERS, for example, the rise in pressure in the left ventricle occurs shortly after the QRS complex and the end of the systole immediately after the T wave. The relations may, however, vary considerably, according to WIGGERS, under different circumstances. In spite of this lack of precision in the direct determination of the dynamic occurrence, ECG is nevertheless very suitable for deciding the reciprocal time relations between different electrokymograms taken under the same conditions.

To obtain the greatest possible accuracy in the direction referred to, as has been stated, we now record a carotid sphygmogram as well. This is recorded by a piezo-electric pick-up unit (Elmqvist). It contains a quartz crystal, which is characterised by the fact that when subjected to pressure variations, corresponding electric charges are set up on the surfaces of the crystal. These variations are transmitted to the input circuit of the electrocardiograph and amplified by the appropriate am-

plifier, which is connected to one of the recording galvanometers. The pressure of the pulse wave is transferred to the crystal by a pad which is placed over the common carotid artery.

On the carotid pressure curve there are two moments which are almost always well marked; they are the commencement of expulsion and the closing of the aortic valves (fig. 10). We have therefore found the sphygmogram to be a useful complement to ECG as a comparative curve. Other cardiodynamic moments, too, can be read off on the sphygmogram, but less consistently.

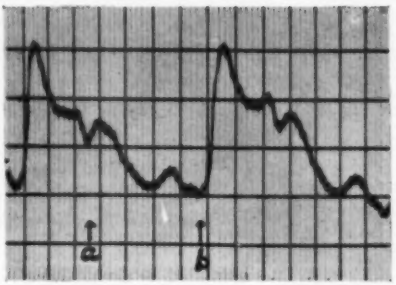


Fig. 10. Carotid sphygmogram recorded with the apparatus described in the text.
a = opening of the aortic valves.
b = beginning of the ventricular expelling phase.

One must not forget the time taken for the wave of pressure to travel from the root of the aorta to the point on the carotid artery where the pad rests. Usually this time-lag should not exceed 0.01—0.02 secs. when the recording system is without time-lag. The variations which may arise in morbid changes of the vessels must also be taken into consideration, but they may not play an important rôle unless they are serious, such as for example aneurysm of the aorta. As far as technique is concerned, it is important that the pad lies right over the vessel, otherwise the sphygmogram is easily distorted.

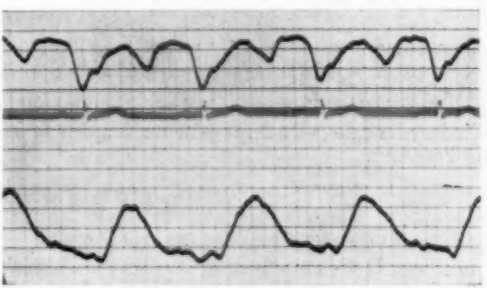


Fig. 11. Synchronously recorded electrokymograms from the left (above) and right auricles.

The possibility of direct internal comparison between two electrokymograms exists, as has been mentioned, because the apparatus is provided with two channels independent of each other (fig. 11).

In general, as may be seen from the above, a roentgen apparatus of the condenser type is used. However, we have also made entirely satisfactory kymograms with an ordinary apparatus (fig. 12). The capacity of the cables has been sufficient to smooth out the ripple, which has only given interference under heavy load. Even in such cases, the result is naturally better if the cables are lengthened.

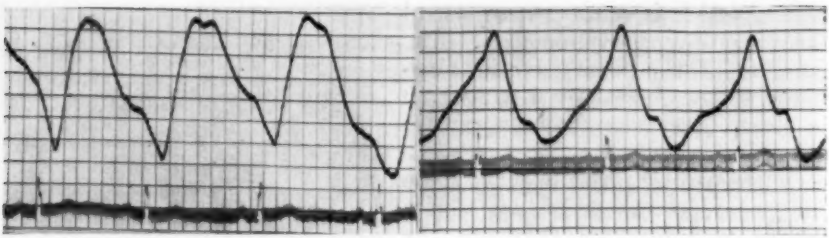


Fig. 12. Electrokymograms recorded with an ordinary roentgen apparatus.

SUMMARY

A new design for an electrokymograph is described. Special attention has been paid to the elimination of interferences. Some considerations of principle in the examination technique are set out.

ZUSAMMENFASSUNG

Es wird eine neue Elektrokymographkonstruktion beschrieben. Besondere Sorgfalt wurde der Beseitigung von Störungen gewidmet. Gewisse prinzipielle Erwägungen inbezug auf die Untersuchungstechnik werden vorgelegt.

RÉSUMÉ

Description d'un nouvel électrokymographe. On s'est appliqué particulièrement à éliminer les causes de dérangements. Exposé de certains principes touchant la technique de l'examen.

REFERENCES

1. Andersson, T.: Acta Radiol. 1948. 30. 36.
2. Best, C. H. and Taylor, N. B.: The Physiological basis of Medical practice. 1945.
3. Chamberlain, W. E.: Acta Radiol. 1947. 28. 847.
4. Evans, C. L.: Principles of Human Physiology. (Starling.)
5. Henny, G. C. and Boone, B. R.: Am. J. Roentgenol. 1945. 54. 217.
6. Henny, G. C. and Boone, B. R.: Am. J. Roentgenol. 1947. 57. 409.
7. Hjelmare, G.: Acta Radiol. 1946. 27. 334.
8. Kjellberg, S. R.: Lecture before the Swedish Medical Society 19. 4. 1949.
9. Luisada, A. A., Fleischner, F. G. and Rappaport, M. B.: Am. Heart J. 1948. 35. 336.
10. Wiggers, C. J.: The pressure pulses of the cardio-vascular system. 1928.
11. —: Physiology in Health and Disease. 1944.

FROM THE ROENTGEN LABORATORY (CHIEF-ROENTGENOLOGIST: Á. KOVÁCS) AND THE ORTHOPAEDIC DEPARTMENT (CHIEF-SURGEON: PROF. B. HORVÁTH) OF THE ST. JOHN HOSPITAL, BUDAPEST, HUNGARY.

HERNIATED DISKS AND VERTEBRAL LIGAMENTS ON NATIVE ROENTGENOGRAMS[1]

by

Ákos Kovács

Owing to the fact that myelography is performed with iodine solutions and oxygen complications due to the myelographies done with iodine-oil have decreased in number (arachnitis, fibrositis) and myelography has become more reliable (LINDBLOM, FISCHER). However, the majority of the cases of herniated or fractured cartilage which could not be demonstrated by the iodine oil method cannot be revealed by these methods either. Lateral herniae or such as situated in the foramen and directed sideward cannot give a characteristic filling defect for their distance from the dural sac. Nevertheless, these herniae are, as claimed by LINDBLOM, no less frequent than those seated intraspinally. It has been learned from many observations (BARTELINK) that the dural sac is, between the segments L_5 and S_1, considerably distended wherefore it does, on myelography, not come into contact with the disk. Their distance is 2 to 4 mm in about 15 per cent of all cases and over 10 mm in 8 per cent. Not infrequently, the findings of operative autopsy and those of the clinical examination are diverging. MURPHY reported on two patients in whom the cartilage hernia was found on the other side than it was expected from the complaints and the examination of the nervous system. Otherwise, neither the lumbar puncture nor the myelography are indifferent operations. LINDBLOM observed untoward side-effects in 10 per cent of his cases (from headache to collapse). Being confronted with the rather justified reluctance of the patients one has, if a herniated cartilage is supposed, to make an attempt with a native roentgen film, even if myelography is planned. Out of the changes seen on the film there are some which serve merely as a guide in the recognition of a cartilage hernia while others may be considered reliable signs.

[1] Submitted for publication, June 11, 1949.

Herniated Disks

Those changes pointing to the degeneration of the disk may be regarded as signs of »suspicion» or likelihood, especially if the disk has become narrower and the missing part cannot be visualised as bulging laterally or forward. This sign is particularly valuable if marginal spurs or ligament calcification show that the protrusion of the disk forward and sideward are slight, while it has become markedly thinner. It is a wellknown fact that the disks are gradually thicker downward to the lumbo-sacral disk; this is slightly thinner in healthy persons also and, as a rule, wedge-shaped. Well, if this series characterised by gradual thickening is interrupted by missing thickening, or flattening, the suspicion of cartilage hernia should be raised. A unilateral or bilateral spondylolysis associated with the deformity of the disk is a strong support of the diagnosis of cartilage hernia. (MEYERDING, GILLESPIE.)

6 cases of spondylolysis occurred in our operated material. This low number cannot be regarded as the basis of reliable statistics. Nevertheless, spondylolysis as a factor deteriorating the statical function of the disk should be pointed out. A further sign is the subluxation of the small joints. The even contraction of the disk due to its aging manifests itself on the oblique films of the joints (DITMAR, GHORMLEY) in a moderate subluxation of the small joints. There is an axial shift of the articular surface toward the neighbour vertebra. Of course, this is a general sign occurring on the whole spinal column or a large section of it. The subluxation of a single joint or two joints lying on the two sides of the same segment points to the isolated disease of the intervertebral disk, occasionally its herniation. A disk hernia is nearly definitely to be assumed if the congruency of the vertebral margins is missing, especially if this anomaly displays various degrees while the spinal column is bent at various angles; this is a sign showing that the cohesive capacity of the disk is defective (Fig. 1 a and b).

Of course, such shifts occur more frequently in the society of spondylolysis, the injury to the disk being partly due to uneven load. If the shift of the margins takes place in the sagittal plane the disk liberated from the even pressure of the coverplate moves in the direction of the diminished pressure (Fig. 2 a). This shift is the first stage in the pathomechanism of spondylolysis. Frequently, this motion cannot be demonstrated on the usual films taken from two directions, the shift taking place in an oblique direction. The shift associated with torsion may best be visualised on the oblique films taken from the joints and the foramina. The torsion shift is more likely to give rise to the herniation of cartilage than is a motion taking place in the sagittal plane because, in such cases, it is the less protected section of the disk lying by the lig.

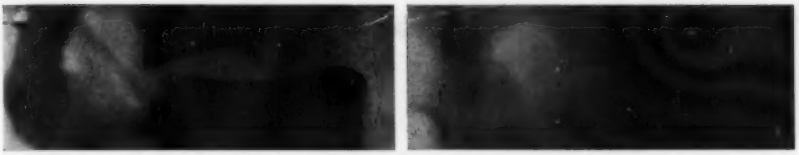


Fig. 1 a. Fig. 1 b.

Fig. 1. a) On backward bending the edges suffer a shift. b) On bending forward they are congruent. Degeneration of the cartilaginous disk.

longitud. post. which becomes free by escaping from below the cover-plate. Care should be taken when the diagnosis »vertebral shift» is stated. If the central ray does not course accurately in the frontal plane the two posterior longitudinal edges of the lumbar vertebra (the margins of the spinal canal) will appear on the film separately (not upon each other) and, if one of these edges is overexposed (for any reason f. i. intestinal gases) it remains invisible while the other edge exhibits a certain shift against the neighbouring vertebrae (Fig. 2 b). Such errors may occur especially with slightly scoliotic or torsive spinal columns.

Out of the sure signs first of all the demonstrable cartilage hernia is to be mentioned. If correct technique is applied this hernia can often be visualised. On films taken from the knee with a suitable technique the menisci are sometimes visible. As shown by BARNES and MC.LACHLAN cartilage contains considerably more proteins and anorganic substance than fats or muscles do wherefore these tissues have different photo-absorption coefficients (fat 1.13, muscle 2.57, cartilage 2.7). Regarding these figures cartilages can be demonstrated by roentgen. The inter-

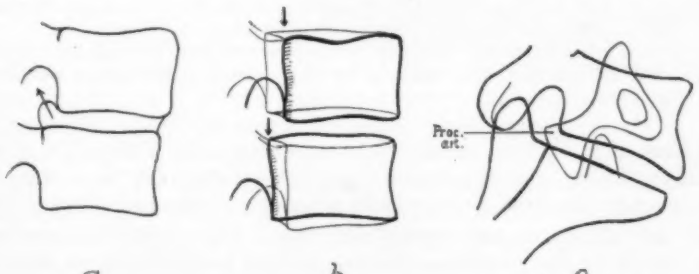


Fig. 2. a) The disk liberated from the constant pressure of the covering plates moves toward the decrease of the pressure. b) One of the posterior longitudinal edges has not been recorded; it can be mistaken for a shift. c) The inferior articular process has been projected upon the lumbosacral foramen and simulates a protruded calcified cartilage hernia.

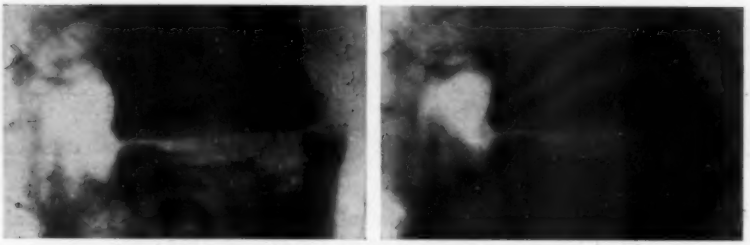


Fig. 3 a. Fig. 3 b.

Fig. 3. a) Benign tumour of the vertebra (angioma?). b) After 4 months a cartilage hernia protrudes backward.

vertebral disk is, on films taken with a good technique, more often visible than one could realise. Of course, the contrast between cartilage and soft parts is the greater the more lime salts are contained by the cartilage. If the lime salts are accumulated in smaller or larger granules the cartilage can be seen on a film made with a wrong technique also. In this manner, some cases of herniated cartilage have been operated on the basis of a native film.

Case 1. H. J., a woman aged 27 years was being observed for a benign tumour of the 4th lumbar vertebra for 9 months (Fig. 3 a). Since August 1948 she had pains referred to the left lumbar region though she wore a corsett or was lying in gypsum bed. On the film taken on the control examination a lentil-sized cartilage hernia was demonstrated which had not been seen on the film made 4 months previously (Fig. 3 b).

Case 2. M. I., a man aged 51 was caught by a painful attack 9 weeks before the examination following a faulty step. He could not walk. The neurologic examination showed missing Achilles reflex (anastomosis?), hypaesthesia and thermoanalgesia. On the film a calcifying cartilage hernia was seen between the 4th and 5th lumbar vertebra (Fig. 4 a). A beansized cartilage hernia was removed through operation (prof. Horváth). On the control film made after the operation the hernia was not more present (Fig. 4 b).

Another sure sign is yielded by the osteophytes formed at the posterior edge of the vertebra, small though they may be. As a rule, osteophytes are produced at those places where the movements are the greatest and the ligaments are mostly distended. The nucleus pulposus bulging backward or the annulus fibrosus gliding backward give rise to the distension of the periosteum adhered to the longitudinal ligament whereby osteophytes are formed. The spurs of the vertebral margin invariably follow the protrusion of the disk. Initially they are neither strong nor particularly broad and they form merely a thin bridge surrounding the protruding part of the disk. With regard to these conditions a small

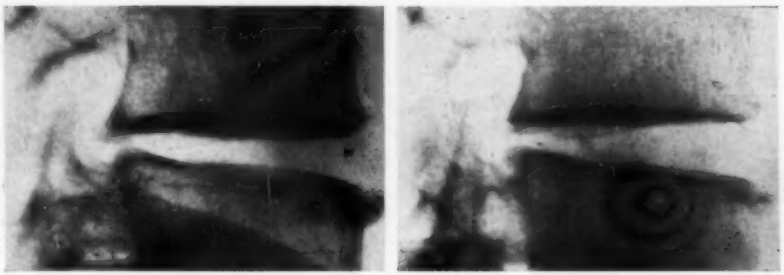


Fig. 4 a. Fig. 4 b.

Fig. 4. a) Calcifying cartilage hernia between the vertebrae L_4 and L_5. b) After the operation the hernia has disappeared.

osteophyte protruding backward is a sure sign that a much larger part of the disk has projected backwards. It has been generally adopted that the spurs of the vertebral margins are harmless roentgenologic signs of aging. This view is warranted aside from the cases in which the spurs are formed on the posterior margin of the vertebra or project toward the foramina.

Posterior osteophytes occur with a special frequency on the lower margin of the 5th lumbar vertebra. It may be superfluous to emphasize that the sacrolumbar region is particularly exposed to injuries and this is the main site of cartilage herniae. (KEEGAN: 53 %, LENHARD-DANDY: 49 %.) Here, the site of the greatest load coincides with that of the greatest motility, further with the disadvantage associated with the walking on two feet of man that the last disk has to catch hold on the plane of the sacral bone tilting forward. Further, anatomic varieties occur in a high number at this place. LÜBKE found a transitional vertebra in 10 per cent of healthy persons. MEYERDING claims that spondylolisthesis occurs in 88 per cent of all cases on this vertebra. It should be emphasized that it does not suffice, for the demonstration of cartilage herniae at this place, to make the usual photographs from two normal directions and the oblique ones but the so-called *lumbo-inguinal* or *inguino-lumbar* film suggested by me for the demonstration of the lumbosacral foramen has also to be made. (Radiologia Clinica. 1950.)

The frontal plane of the patient and the plane of the film form an angle of 60°. The central ray is cranio-caudally directed to the lumbosacral disk at an angle of 25° or 30°, in men and women respectively.

SOLOMON reported on 629 cases in 1948. By means of the usual films made of the vertebral column he could demonstrate marginal osteophytes giving rise to radicular irritation in 12 (2 per cent) of his cases. We succeeded to find osteophytes and calcified cartilage hernia with the aid of

Fig. 5 a.

Fig. 5 b.

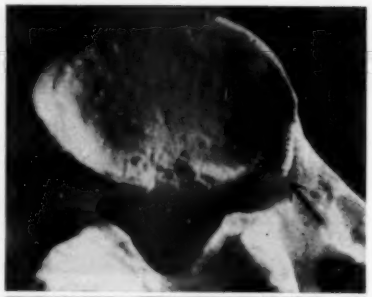


Fig. 5 c.

Fig. 5. a) No change on the profile film. b) Sciatica hook (osteophyte of the vertebra L_5). c) The hook is clearly visible on the film taken from the foramen.

the technique described in 117 of 175 cases (osteophytes in 49 and calcified hernia in 68 cases). 40 of these patients have been operated mainly on the basis of the roentgen diagnosis. This diagnosis was ascertained by the operative autopsy in 36 cases. Apparently, the hernia of one patient has escaped before the operation. There was only a cavity in the soft disk at the site of the pulpous nucleus. In three patients the hernia could not be found but the large osteophytes could be palpated. These patients had suffered from sciatica for many years. Evidently, disk and hernia gradually underwent shrinkage while the spurs became stronger. The decompression associated with the laminectomy brought about relief in these cases also. The marginal osteophyte surrounding the hernia or disk slipping backward has, with regard to its shape resembling a reversed hook and its particular importance, been termed »*sciatica hook*». On Fig. 5 b the sciatica hook of a patient having a cartilage hernia has been recorded. The films recorded on Fig. 5 a and 5 c have been taken from the anatomic preparation. The sciatica hook cannot be visualised but on the *lumbo-inguinal* photographs, this region being, on the frontal film, covered by the sacral bone and its articular processes.

Among the morbid changes seen on the lumbo-inguinal film there may be such as exerting pressure on the L_5 root whereas others involve the root S_1. Through the intervertebral foramen one can visualize a long section of the posterior margin of the vertebra. There is, viz., a morphologic difference between the vertebra L_5 and the other lumbar vertebrae: on its posterior aspect there is no impression due to the spinal canal, the basis of the vertebra is a semicircle (Fig. 5 b). Therefore, several rays may touch it tangentially. Regarding this fact the procedure is to be considered advantageous because the changes occurring in the midline can be observed on these films. The same property of the film is its drawback at the same time viz. that one cannot tell the structures of the posterior margin from those within the foramen. The posterior margin of the vertebra L_5 is seen through the foramen like through a window. Changes in the foramen give rise to complaints referred to the segment L_5 whereas the changes of the posterior border cause complaints in the innervation area of S_1 (KEEGAN). However, the protrusion situated in the midline may exercise a pressure on the root L_5 also, as it is the case with large cartilaginous herniae. If the foramen is wide enough the place of a well visible sciatica hook can be rather accurately determined through two films. On a film taken at an angle of 20°—25° to the frontal plane the medial marginal spur is more projecting than the lateral one whereas on the typical film (30°) the lateral spur is longer. The hook seen on Fig. 5 c is laterally situated wherefore it ought to have exerted pressure on the root L_5.

There is no correlation between the size of the »sciatica hook» and that of the cartilage hernia. Initially *i. e.* while the hook is being developed it is, of course, smaller than the hernia. After some months and repeated recurrences the hook reaches about as high as to the upper margin of the hernia. Several years later the hook is still present whereas the cartilage does, owing to fluid loss, undergo shrinkage and it may thoroughly disappear. At this time, complaints are due to the hook only.

Case 3. K. O., a man aged 48 had been observed for recurring sciatica for 12 years. The films made during these 12 years displayed no morbid change beside the thinning of the cartilaginous disk and spurs due to spondylosis. There was, on the lumbo-inguinal film, an osteophyte present protruding deep into the right presacral foramen. Operation was suggested. On the laminectomy (prof. Horváth) no cartilage hernia was found but a sharp marginal osteophyte could be palpated (sciatica hook). The decompression brought about by the laminectomy resulted in a complete relief of the disease which had lasted for 12 years. Since the operation, 7 months have elapsed without complaints.

Case 4. K. J., a woman aged 42, had had pains in the lumbar region and lancinating pains radiating into the left leg for several years. Apart from a hardly perceivable Lasègue sign of the left side there was no neurologic symptom. Roentgen film: The first sacral segment was of transitional character, the sacrolumbar disk slightly wedge-shaped. The

Fig. 6.

Fig. 7.

Fig. 6. The sacrolumbar disk is slightly thinned. Sciatica hook.

Fig. 7. Cartilage hernia lying below the sciatica hook may be assumed.

Fig. 8.

Fig. 9.

Fig. 8. Cartilage hernia below the sciatica hook is clearly seen.

Fig. 9. Flattened disk. The greatest part of the cartilage is bulging forward; this can be seen from the marginal spurs. Still, there is a cartilage hernia and a sciatica hook.

left sacrolumbar foramen recorded on a lumbo-inguinal film showed a thick hook, verging upward, on the posterior-inferior edge of the 5. lumbar vertebra, as a sign of a herniated cartilage below it (Fig. 6). Operation: Laminectomy (dr. Szász). Left to the midline there were two cartilage herniae the size of bean and pea, respectively. Both have been removed.

Case 5. K. G. There was a cloudiness below a thin needle-like hook, a sign of the herniated cartilage (Fig. 7). On the operation (dr. Glauber) a tough piece of cartilage (backward projection of the annulus fibrosus) has been removed. The *Case 6* of M. G. (Fig. 8) was similar; the hernia can be clearly seen below the hook.

Case 7. Sz. I. The major part of the flattened cartilaginous mass was protruding in front, as it could be seen from the large marginal osteophyte of the vertebra L_5 and the sacral bone. The hook directed backward has persisted after the removal of the cartilage (operated by prof. Zinner, Fig. 9).

Fig. 10 a.

Fig. 10 b.

Fig. 10. a) Flattened sacrolumbar disk. b) Enormous sciatica hook invisible on the profile film.

Case 8. E. L., should be reported because this is an example showing that the profile film alone is not sufficiently informative. On Fig. 10 a the flattened disk only can be seen whereas the photograph made of the presacral foramen exhibits an extensive sciatica hook (Fig. 10 b).

Attention is to be paid to a source of occasional errors. When the lumbo-sacral foramen is projected the contralateral sacrolumbar joint is recorded upon the vertabral body. If, on taking the photograph, the frontal plane of the patient was insufficiently directed towards the film the posterior edge of the inferior articular process of the vertebra L_5 may appear behind the disk where it covers the area to be examined and may give rise to erroneous conclusions (Fig. 2 c). By changing the angle of tilting by some degrees the foramen becomes free.

The importance of the sciatica hook may be seen from the results of the operations accomplished for the alterations of the *sacrolumbar* disk. The operations based on the changes seen from the native photographs. Here is the distribution of the changes:

	Non-operated	Operated
Sciatica hook	29	16
Calcified disk	26	12
Calcified ligament	4	1
Deformed articular process	0	1
Total	59	30

Thus 53 per cent of the cartilage herniae occurring below the vertebra L_5 could be revealed through the sciatica hook. This is the most relevant conclusion to be drawn from the lumbo-inguinal film.

Herniation of the cartilage L_5—S_1 can be demonstrated on native films in a higher percentage than they occur in great operation statistics. This is the distribution of 99 cases.

	Kovács (roentgen)	Keegan	Lenhard-Dandy	Alajuanine-Thure
L_{2-3}	2 % (2)	1 %		
L_{3-4}	4 % (4)	5 %		
L_{4-5}	25 % (25)	39 %	44 %	55 %
L_5—S_1	69 % (68)	53 %	49 %	40 %

Obviously, the herniated disks of the sacrolumbar region attain rather rapidly and more frequently that degree of degeneration by means of which they can be recorded on native films. These herniae being the very cases to be demonstrated by the lumbo-inguinal photograph the processes occurring between the vertebrae L_5 and S_1 can nearly invariably be detected without myelography whereas the processes of the space L_4—L_5 frequently cannot be revealed if native films only are prepared.

If the foramen is freely projected *i. e.* without a bony opacity covering it to the space between the ant. inf. iliac spina and the symphysis, and to the area below the arch of the vertebra L_5, the roentgen photograph of the degenerated and partly calcified cartilage appears within the opacity formed by muscles and the epidural fat tissue. However, it is often visible through the iliac bone also. The lime deposit formed in the herniated cartilage or the disk slipped backward could be demonstrated in 41 of our 175 cases, the whole hernia in 28 cases.

Case 9. H. L., a woman aged 36, fell backward 7 months before the examination. For some days she had low back pains. Then the symptoms of a severe sciatica occurred and persisted in the last 2 months. Lasègue's and Braggard's signs were present. There was a hypaesthesia behind the lateral malleolus and at the lateral margin of the foot. The Achilles tendon reflex could not be elicited on the right side. Roentgen examination: Only the lumbo-inguinal film showed a change. A hazelnut-sized opacity of lime intensity was present in the right presacral foramen (Fig. 11 a). On operation (prof. Horváth) a piece of cartilage the size of a large bean was, slightly laterally, found and removed. Then the removed cartilage was placed near by a piece of muscle of the same height and both have been taken on a film. The difference of intensity due to the lime contents of the cartilage can be well seen (Fig. 11 b). Histology (dr. Kálló): there were deposits stained with haematoxylin in the fibrous cartilage (lime).

Case 10. B. S. Similar history and identical nervous signs as in the previous case. On the lumbo-inguinal film a cartilaginous disk, projecting backward, with spotty calcification was seen (Fig. 12). Operation and histology revealed, in this patient also, calcifying fibrous cartilage.

Case 11. V. A., a woman aged 45 lifted a heavy thing 5 months before the examination. Since then, she had low back pain radiating into the right leg and she could not erect herself. Examination of the nervous system: Lasègue's and Braggard's signs were positive on the right side, she had a hypaesthetic area behind the external malleolus,

MÜLLER RT 200

för djupterapi

En ny, högeffektiv röntgenapparat från C. H. F. Müller, Hamburg

Effekt 20 mA, 200 kV likspänning.

Modern oljekåpa med små dimensioner möjliggör inställning i alla lägen. Röntgendos 75 r/min vid 50 cm fokus-hudavstånd, halvvärdeskikt 1,1 mm Cu. Högspänningsgenerator tillsammans med rörstativ erfordrar en golvyta av endast 0,8× 0,8 m och inbesparar särskilt maskinrum.

DANSK RÖNTGEN-TEKNIK A/S · KÖPENHAMN · AARHUS
CHRISTIAN NISSEN · HELSINGFORS
NORSK A/S PHILIPS · OSLO

SVENSKA AKTIEBOLAGET PHILIPS RÖNTGENAVDELNINGEN • STOCKHOLM 6

HAVE YOU SUBSCRIBED TO THE

ACTA RADIOLOGICA?

Please note that from 1948 on, two volumes are published annually.

The ACTA RADIOLOGICA, published by the Radiological Societies of Denmark, Finland, Holland, Norway, Sweden, and Switzerland, contain original articles on roentgen diagnostics and radiotherapy, in English, French or German, every article being furthermore supplemented with summaries in all those three languages. Each volume contains about 500 pages published in six numbers and is richly illustrated. So far, 31 volumes and 77 supplementary volumes have been published.

Subscription rate per volume: Swedish Crowns 35.— postage for non-Scandinavian countries, 3 Sw. Crowns additional. (Thus annual subscription rate: 76 Sw. Crowns.) Single copies 7 Swedish Crowns plus postage.

EDITOR:

GÖSTA FORSSELL, M. D.

NO RADIOLOGIST CAN GET ALONG WITHOUT THE

ACTA RADIOLOGICA

Subscription through *Acta Radiologica, Stockholm 2* (Sweden) or through the booksellers.

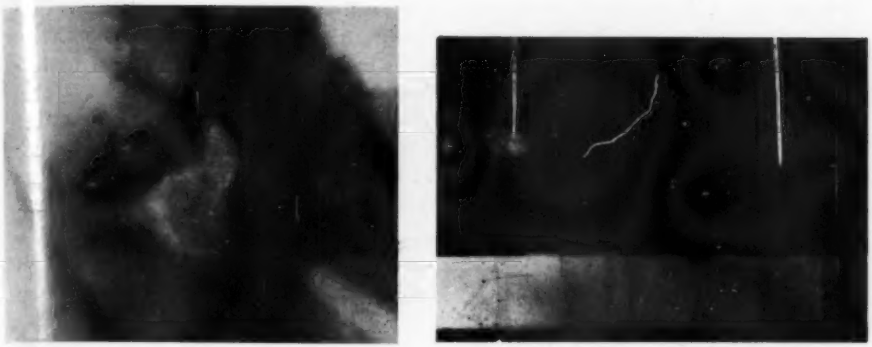


Fig. 11 a. Fig. 11 b.

Fig. 11. a) Over hazelnut-sized cartilage hernia nearly filling the whole foramen. b) Photograph of the cartilage hernia containing lime and a piece of muscle of similar size. Centimeter scale of aluminium.

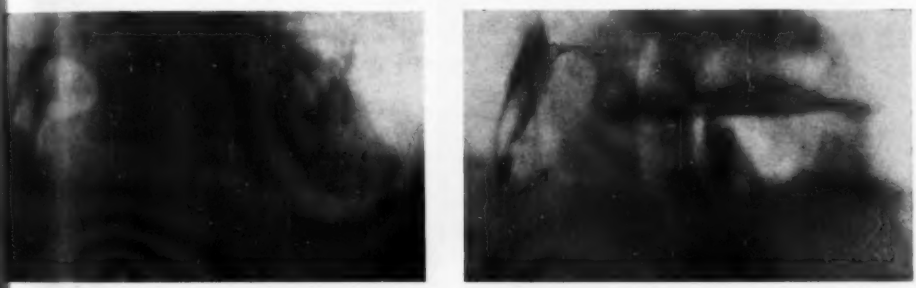


Fig. 12. Fig. 13.

Fig. 12. Backward bulging disk with lime spots.

Fig. 13. The metastasis of an ovarian cancer projects into the presacral foramen.

weak knee jerk, and no Achilles tendon reflex. She was anaemic, having 1,800,000 red corpuscles and 9,300 white blood cells. Roentgen film: There was a hazelnut-sized protruding structure in the presacral foramen recorded on the right lumbo-inguinal photograph (Fig. 13). The patient was transported to the internal department, in order to treat her for the anaemia. In 6 weeks she developed hypotonic paresis of the right leg with positive Babinsky sign. She was operated for an assumed extradural tumour. On laminectomy a half-hazelnut-sized berry-like structure exerting an upward pressure on the root S_1 was found. After the removal of this structure there remained a cavity back at the site of the disk which was about as large as a third phalanx. The patient succumbed to postoperative pneumonia and shock. On necropsy an ovarian cancer was revealed.

Roentgenograms prepared with a special technique may be needed also on the examination of disks lying higher up which can more readily

be recorded. If the vertebrae appear on a profile photograph with a distorted shape (normally they are regularly quadratic) reduction of the vertebrae through any support is tried in all cases. To this end, orthopaedic procedures such as extension and infiltration with anaesthetic solutions are applied. If even the pairs of vertebrae forming the border of the disks cannot, through reduction, be brought into an orthoroentgenograde position attempts may be made to direct the rays to the cartilage space by tilting, according to the distorted column, the central ray or by means of a tube (BEGG).

Meninges and Spinal Ligaments

In the inflammatory processes spreading to the dura and the ligaments little can be expected from roentgen diagnostics. Their anatomic conditions, the situation of dural and root pouches are being clarified through myelographic studies in living and dead bodies (LINDBLOM, STENSTRÖM). The inflammatory processes occurring in the ligaments can be revealed by the presence of lime foci. Calcification is, of course, preceded by swelling and thickening of the ligament. Any visible calcification ought to have been preceded by a considerably more extensive inflammatory process. As it may be seen from the preparation made after necropsy (Fig. 14) the calcified spot is relatively small in comparison with the ligamentum latum. Suppose that the ligament is, below the calcified section, prolonged to the lower border of the same vertebra and realize that there were, above the calcified section, soft parts consisting of connective tissue removed on preparation; then it will be easy to imagine that there was a marked hindrance to the emerging root and its venous plexus. SÁNTHA has pointed out that changes of the cartilage and the ligamentum flavum give rise to severe degeneration of the roots manifesting itself in serious histologic changes. He observed *e. g.* the breakdown of the myelinic sheath and the proliferation of the cells of Schwann's sheath. POLGÁR has, while concerned with the ossification of the spinal ligaments, distinguished the (interarcual) calcification of the ligamentum flavum and a retrocorporal calcification in which a long

Fig. 14. Calcification of the ligamentum flavum.

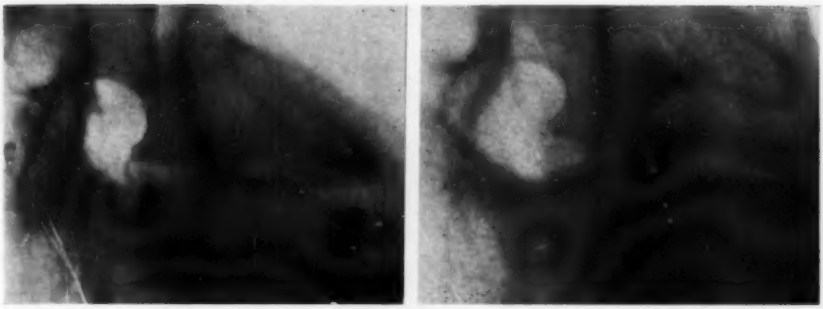


Fig. 15 a. Fig. 15 b.

Fig. 15. a) Lime strip in the posterior longitudinal ligament after the osteomyelitis of the vertebra. b) After the operation.

hook passes from the lower border of the vertebra to the arch lying below it (spondylosis) whereby the intervertebral foramen is narrowed. SCHMORL and JUNGHANNS observed retrocorporal ossification of the vertebra only in one of 10,000 cases examined post mortem. Ossification of the ligamentum flavum was seen more frequently but it was independent of the other prevailing morbid processes of the vertebrae. They are often associated with diseases causing rigidity of the spine (spondylarthritis, senile kyphoscoliosis). In our opinion, these changes occur much more frequently and they could be demonstrated by careful roentgen examination in the majority of cases. Out of our cases only those verified by operative autopsy should be reported though there is little doubt that the changes were due to radiculitis in the other cases also.

Case 12. D. A. The woman aged 33 was awakened on July 5. 1948 by fever rising to 39.5° C and low-back pain whereby she could not get up. After 2 months which she spent in bed with a temperature febrile and subfebrile alternately she was admitted to a hospital. Roentgen film: There was a half-lentil-sized, unsharply limited rarefication in the posterior-inferior angle of the body of the L_5 vertebra. Penicillin was administered for an assumed subacute osteomyelitis. She became afebrile while the pains and the immobility increased. There was no morbid reflex or sensory disorder present. The film taken on Dec. 5. (profile and ventro-dorsal) showed a slight osteosclerosis of the L_5 vertebra. On the lumbo-inguinal film taken from the right presacral foramen a moderate backward protrusion of the disk and a fascicular calcification of the posterior longitudinal ligament was seen (Fig. 15 a). Operation (prof. Horváth): Laminectomy. The protrusion was clearly felt at the posterior lower border of the vertebra L_5. The root S_1 was adherent to the border of the vertebra. The adhesion has been detached, then the root returned to its old place. The ligament was very thick; while it was being removed with the scalpel the latter broke. After recovery the diseased presacral foramen was again examined with roentgen; there was, of course, no calcification of the ligament present (Fig. 15 b).

Fig. 16. The calcification in the posterior longitudinal ligament points to the slightly bulging disk.

Case 13. Sz. L. The patient, a man aged 37, had had low-back pain associated with a considerable scoliotic distortion for 4 years. Neurologic examination: On the left side the Achilles reflex was diminished and there was a positive Lasègue sign, no marked sensory disturbance. Roentgen examination: The disk lying between the vertebrae L_4 and L_5 was thin and wedge-shaped. The bodies of the vertebrae were incongruent. At the site of the cartilaginous protrusion the posterior longitudinal ligament was calcified (Fig. 16). On the oblique film taken from the joint there was spondylolysis on the left side of the arch of L_5, along the interarticular section. Operation (prof. Horváth): After laminectomy the protrusion of the disk was clearly palpated but no herniation was present. A meshwork of varicous veins consisting of thick branches like a penholder was seen level the protrusion. The decompression accomplished by the laminectomy resulted in complete recovery.

In rare cases the place where the longitudinal ligament has torn can be demonstrated.

Case 14. A man aged 38 (K. I.) had typical complaints referred to sciatica. The usual film showed no alteration. On the lumbo-inguinal film two calcified parts of the

Fig. 17. Tear of the pos. longit. lig. due to herniated cartilage.

Fig. 18 a.

Fig. 18 b.

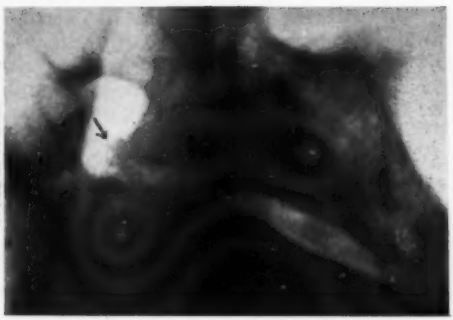


Fig. 18 c.

Fig. 18. a) Lumbo-sacral transitional vertebra. b) The right foramen narrowed by the broad pars lateralis. c) The lime foci of the herniated cartilage can be seen through the left foramen.

ligament, corresponding to its distended and torn section, could be seen like two needles (Fig. 17).

Transitional Vertebra

The lumbo-sacral vertebra of transitional character represents a great diagnostic difficulty. Roentgenologic orientation is nearly impossible, the number of the varieties being rather high. The localisation of the complaints is rendered more difficult by the fact that developmental anomalies of the bones are frequently associated with those of the nervous system. Nevertheless, degeneration of the cartilaginous disk may in such cases also have a prevalent rôle. In the statement of DE SÉZE and SALOFF, the sacrolumbar spine is, in cases of normal bone system, composed of

three functional parts: 1) The fix sacral bone, 2) the semimobile vertebra L_5 tied to the pelvis by elastic ligaments, and 3) the mobile vertebra L_4. If there is a transitional vertebra between the iliac bones the overlying vertebra cannot be fixed by elastic ligaments and the junction of fix sacral bone and mobile lumbar spine give, representing an overload, rise to degeneration. The lumbo-inguinal film is a help in establishing the conditions.

Case 15. M. L., a man aged 36, displayed a spina bifida, further a transitional vertebra possessing a broader pars lateralis on the right side and a narrower one on the left side. These (transversal) processes formed an articulation with the sacral bone. There were no symptoms of bony reaction (arthrosis) in the joint. (Fig. 18 a.) The lumbo-inguinal films showed a marked difference between the two sides: the right foramen was considerably narrower, resembling a flat dumb-bell. Its posterior wall was formed by the posterior wall of the closed sacral canal, instead of being formed by the articular processes. (Fig. 18 b.) Probably, this narrow foramen was associated with a thinner root and an underdeveloped venous plexus, as could be inferred from the fact that the complaints of the patient were referred to the other side characterised by a broad foramen. Through this foramen of normal width small, pearl-like lime foci appeared as signs of the herniated cartilage. (Fig. 18 c.) Operated by prof. Verebély.

SUMMARY

Native films taken by trained and skilled roentgenologists on the basis of orthopaedic principles render myelography superfluous in 80 per cent of cases. Such native films are indispensable if myelography cannot be informative for anatomic reasons. These roentgenograms of the vertebral column should be made with the same exactitude as the projected partial roentgenograms of the skull. If any, even the slightest, deformity is present the temporary abolishment of the deformity is attempted or, according to the displacement of the vertebra, the central ray is so directed that a thorough profile of two vertebrae and the disk lying between them be obtained. The lumbo-inguinal films recording, on the basis of the same principles, the presacral foramens usually demonstrate the majority of the sacrolumbar cartilage herniae and ligament calcifications.

ZUSAMMENFASSUNG

Wenn Nativaufnahmen von sachverständiger Hand auf Grund orthopädischer Prinzipien angefertigt werden, ist die Myelographie in 80 Prozent der Fälle überflüssig. Wenn aber die Myelographie aus anatomischen Gründen nicht hinreichend aufschlussreich sein kann, ist die Nativaufnahme unentbehrlich. Diese Wirbelaufnahmen sind mit derselben Genauigkeit anzufertigen, wie die hervorprojizierten Teilaufnahmen des Schädels. Im Falle selbst der geringsten Deformität versuchen wir die Deformität, wenigstens vorübergehend, zu beheben, oder den Hauptstrahl, entsprechend der veränderten Lage des Wirbels, so zu richten, dass von je zwei Wirbeln und der zwischen ihnen befindlichen Knorpelscheibe ein genaues Profilbild entstehe. Die auf Grund derselben Prinzipien hergestellten lumbo-inguinalen Aufnahmen, die zur Darstellung der Foramina praesacralia dienen, weisen die Mehrheit der sacrolumbalen Knorpelbrüche und Bandverkalkungen nach.

RÉSUMÉ

Le roentgen film pur, exécuté selon des principes orthopédiques et par un expert entraîné, est capable de rendre la myélographie superflue dans 80 pourcent des cas; par surcroît, il devient indispensable dans les cas ou pour des raisons anatomiques, la myélographie n'est capable de nous donner des renseignements. Une telle image de la colonne vertébrale doit être réalisée avec toute la précision que requièrent p. e. les roentgenogrammes limités, spécialement projetées du crâne. En présence de la plus infime differmité, on procède d'abord à une tentative de suppression — le cas échéant temporaire — de cette difformité par les méthodes de l'orthopédie, ou bien, conformément à la situation vertébrale altérée, le rayon d'incidence normale est dirigé de façon à reproduire une image de profil achevée de deux vertèbres avec le disque intermédiaire. Sur la base de ces mêmes principes les incidences lombo-inguinales imaginées pour la représentation des trous de conjugaison présacrés peuvent être misses au service de la reproduction de la majeure part des hernies discales sacrolombaires et des calcifications ligamentaires.

REFERENCES

1. Alajuanine and Thurel: La Semaine des Hôpitaux de Paris 23: 2794 (1947).
2. Barnes and Mc.Lachlan: Am. Journ. Roentg. 50: 366 (1943).
3. Bartelink: Radiology 50: 2. 202 (1948).
4. Begg and Falconer: Brit. Jour. Surg. 36. 143. 225 (1949).
5. Fischer: Schweiz. Med. Woch. 79: 213 (1949).
6. Gillespie: Brit. Journ. Rad. 22: 257 (1949).
7. Keegan: Arch. Surg. 55: 246 (1947).
8. Kovács, Á.: Orvosi Hetilap 90: 93 (1949).
9. —; Radiologia Clin. 19: 1 (1950),
10. Lenhard: Bon. J. Surg. 29: 425 (1947).
11. Lindblom: Acta Radiologica 22: 711 (1941).
    —: Acta Radiologica 25: 195 (1944).
    —: Acta Radiologica 28: 69 (1947).
12. Lübke: Arch. Klin. Chir. 163: 707 (1931).
13. Meyerding: Surg. 54: 371 (1932).
14. Murphy: Am. Journ. Roentg. 61: 77 (1949).
15. Polgár: Fortschr. Rtg. 40: 292 (1929).
16. Sántha and Haberland: Orvosek Lapja. 4: 1570 (1948).
17. Schmorl and Junghanns: Die gesunde und kranke Wirb. (Thieme 1932.)
18. De Séze and Saloff: Bull. d. Hôpitaux de Paris. 63: 734 (1947).
19. Solomon: Am. Journ. Sc. 214: 163 (1947).
20. Stenström: Acta Radiologica 29: 303 (1948).

FROM THE RADIUM CENTRE FOR JUTLAND, AARHUS, DENMARK
(CHIEF: PROFESSOR CARL KREBS, M. D.)

ROTATION TREATMENT OF CANCER OF THE ESOPHAGUS[1]

A Clinical Material

by

Carl Krebs, Howard Nielsen, and *Poul E. Andersen*

Introduction

Some of the difficulties encountered in utilizing roentgen rays in the treatment of deep-seated cancers have been of a purely physical nature, caused by the distribution and absorption of radiation in the tissues. By means of modern cross-fire technique it has been attempted to evade these difficulties and to improve the depth effect, sometimes by costly procedures by the aid of high voltage, intense filtration, long focus-axis distance, and time-wasting adjustments.

A simple and obvious application of the cross-fire technique was suggested by HANS MEYER already in 1913 and tried in practice by KNOX & CAULFIELD in 1915. It was the so-called rotation or convergence irradiation. In this country JENS NIELSEN, the Radium Centre, Copenhagen, was the first to adopt this method of treatment (April 1941).

The new principle, movement of the roentgen tube in relation to the patient during the treatment, which was then introduced into the irradiation technique, has since been applied in many ways, partly as rotation irradiation (see inter alia HENSCHKE), and partly as convergence irradiation (NAKAIDZUMI & MOTIDA).

Apparently, the rotation irradiation combined all the advantages of the cross-fire technique with an ideal distribution of the radiation, so that a maximum depth dose and a low skin dose were obtained. In a comprehensive work based on a number of dosage determinations one of us (H. N.) has shown that the theoretical conceptions of the distribution of the radiation do not at all hold good in practice. The varying

[1] Read at the Meating of the Northern Association for Medical Radiology, Stockholm, June 10—12, 1949; submitted for publication, July 2, 1949.

degree of absorption in the body and its contents of tissues, bones, and air spaces must be taken into account. This holds good especially of the pelvic region, in which an unexpected and peculiar distribution of the radiation is obtained.

As far as the thorax is concerned, conditions for irradiation of the organs are very favourable in the middle mediastinum because the air spaces of the lungs counteract the incongruence of the thorax, so that the distribution of radiation approaches that of the circular, cylindrical phantom. The depth dose obtained in the thorax is thus — calculated as the ratio between the maximum dose and the surface dose — from 180 to 285 %. Also as far as the cardia is concerned, the conditions are favourable; if thus 360° rotation is used, and the central beam is directed towards the cardia (HOWARD NIELSEN, 1948, Figs. 57 and 58), a nuclear field in the cardia and a comparatively low dosage of the region to the right of the medial line (the liver region) are obtained; a further improvement of the distribution of radiation can be obtained by 180° rotation over the left side with the central beam directed towards the cardia, but in this case the depth dose is somewhat smaller (HOWARD NIELSEN, 1948, Fig. 61).

On the basis of the isodoses mentioned in HOWARD NIELSEN's thesis and previous publications by other authors (FLAX, DESSAUER, DE ROCHEMONT, NAKAIDZUMI & MIYAKAWA, NEUMANN & WACHSMANN, and JENS NIELSEN) we have treated approximately 500 cancer patients at the Radium Centre in Aarhus, including the cases of cancer of the esophagus and cardia reported in the present paper.

Technique

For two years we used the rotating chair under fluoroscopic control of the patient by means of the therapy beam according to the technique stated by NAKAIDZUMI & MIYAKAWA, NEUMANN & WACHSMANN and JENS NIELSEN. We have now abandoned the fluoroscopic control in favour of the following method, which in our opinion is easier for the staff and equally safe since also in this case where the patient is completely fixed, it is possible, if necessary, to initiate and control his position by fluoroscopy in two planes at right angles. Our present procedure is as follows: The patient is examined fluoroscopically with a contrast medium in the esophagus, and while roentgenograms are taken to disclose the site and extent of the cancer, the localization of the tumour is marked on the surface of the thorax in two projections at right angles. By means of the roentgenograms the size of the axis field is determined, and at the same time the daily dose and the irradiation plan are fixed in such a way that we endeavour to give a tumour dose of approximately

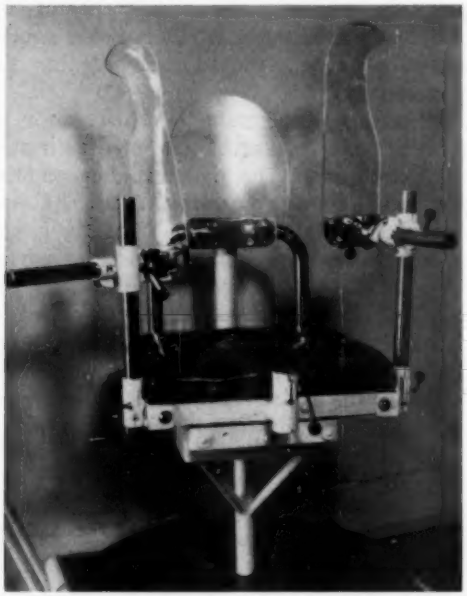


Fig. 1. The rotating chair with adjustable back and laterai supports (JØRGEN KREBS)

5—6,000 r in the course of 30—40 days, which corresponds to approximately 15,000 r measured in air. The patient is placed in the rotating chair (Fig. 1), the seat of which may be moved in two planes at right angles. By means of a light beam marking the central ray the operator places the tumour in the axis of the chair, so that it forms the centre of rotation. If the tumour is located in the middle of the thorax or in the cardia, the patient is instructed to lift his arms over his head and support his hands (and forehead) on a specially designed T-shaped arm rest. In order to give further support to the patient he is encased by three plastic splints straped against the chest, so that he is completely fixed in this position during treatment lasting from 10 to 20 minutes according to the dose. Being supported by the plastic splints even patients in a very poor condition can remain in this position without moving. The advantage of this procedure is that the adjustment technique is very simple and safe.

We use a constant focus-axis distance of 50 cm. The size of the field is determined as the axis field, *i. e.* the field in the axis of rotation generally 5 × 15 cm. The treatment is given by a Philips Super T unit (Villard circuit, grid-controlled), the factors of irradiation being 170 kv.

$\frac{1}{2}$ mm Cu (H. V. L. 0.7 mm Cu). The dosage refers to air measurement at a distance of 50 cm, so that the tumour dose is calculated at approximately 150 r at each treatment.

Supplementary Treatment: The rotation treatment is *per se* a rather strenuous procedure for the patients. They are often debilitated and under-nourished, anemic, with symptoms of vitamin deficiency, and may frequently be found to be out of acid-base equilibrium, slightly acidosic, and with a low serum protein concentration. Therefore it is desirable to improve their general condition as far as possible, inter alia, by blood transfusions and administration of extra vitamins, especially complex vitamin B preparations, liver preparations, glucose saline solutions parenterally or rectally, amino-acid preparations, etc., and we think that this additional treatment has made it possible to carry through the treatment of patients who would otherwise have been unable to sustain it.

The Patients

A total series of 217 patients suffering from cancers of the esophagus and cardia has been treated according to this method, although the treatment has varied to some extent in the initial experimental stage.

Age and Sex Distribution: The 217 patients comprised 137 men and 80 women. The average age at the first admission of all the patients was 66.6 (66.0 for men and 67.6 for women). The majority of the cases occurred in the age groups 51—60 years, 61—70 years, and 71—80 years. As far as the male patients were concerned, 92 % of the cases were found in these age groups, but only 75 % of the female cases, which were more widely distributed. Both the oldest patient (87 years 2 months) and the youngest (37 years) were women. Of the entire series of patients 8.3 % were over 80 years of age, and on the whole there were many patients of advanced age.

Duration of Disease before Admission: The average time elapsed from first symptom to admission was approximately five months (for men a little more (5.24 months), for women a little less (4.7 months)).

There was a distinct relation between the duration of symptoms before admission and the site of the tumour in the esophagus, as it appeared that, in spite of the symptoms, the period till the patients presented themselves for treatment increased with the distance from the teeth to the tumour. The duration of symptoms before admission has been twice as long for cancers of the cardio-esophageal junction as for those involving the upper third of the esophagus.

The Site of the Tumours: Ten per cent of the tumours were situated in the upper third of the esophagus (with the highest incidence in women), 30 per cent in the middle third, and 35 per cent in the lower third.

Twenty-five per cent of the cases were cancers of the cardia, which has the highest incidence in men.

Histology: Microscopic examinations revealed carcinoma in 111 cases (with or without autopsy). The tumour was histologically verified only in about one half of the cases, primarily because of the wish to avoid esophagoscopy in debilitated patients and in patients over 70 years of age. The justification of including histologically unverified cases is, of course, open to discussion. But we have found that the diagnosis must be considered sufficiently established if a case presents a characteristic anamnesis, typical roentgen findings with typical reaction on treatment, and finally shows characteristic symptoms in the terminal stage of the disease, often with palpable or roentgenographically demonstrable metastases. Incidentally, the results have been poorer in the histologically unverified cases (see below). Naturally, the site of the tumour has also had a certain influence on the number of biopsies; thus biopsy was performed on 85 % of the tumours involving the upper third of the esophagus, but only on 20 % of the cardiac tumours.

Of the 111 tumours subjected to microscopic examination 31 were *prickle-cell carcinomas*, 31 *basal-cell carcinomas*, 12 *adenocarcinomas*, and 38 *solid, less differentiated carcinomas*. In one instance both adenocarcinoma and prickle cell carcinoma were revealed.

As in most other reports, the prickle-cell carcinomas most frequently involved the upper third of the esophagus, while adenocarcinomas showed the highest incidence in the lower third. By the microscopic examination it was found that 16 % of the tumours involving the lower third of the esophagus and 30 % of the cardiac tumours were adenocarcinomas.

Result of Rotation Treatment

In many cases it was, of course, obvious at the institution of treatment that owing to the presence of distant metastases no curative effect was obtainable, but only a certain palliation, while in others, in which no metastases were demonstrable, we hoped to cure the patients. We have therefore tried to evaluate the curative and palliative effects of the rotation therapy.

1) *Curative Effect.*

By the cross-fire technique previously used the curative effect of roentgen therapy, and incidentally also of radium therapy, in cancers of the esophagus and cardia has been very slight. As late as 1947 FLEMING could find in the literature only 10 cases with a duration of life of five years or more, and of these 10 cases at least one was reported subsequently to have died from metastases. There is thus no question of any

actual percentage of cure, and the average duration of life is very short. Most authors (*e. g.* McGIBBON, CLAYTON, DORMANNS, CADE, and FLEMING) state that the average duration of life after diagnosis is approximately five months or less, even if intense cross-firing is employed, and the majority of the patients — most frequently 55—65 % — die within six months.

The average duration of life in the present series (reckoned from the day of admission to death or to February 1st, 1949, respectively) was 8.1 months (for men 7.7 months, for women 8.6 months). In comparison it may be stated that the average duration of life for patients suffering from cancer of the esophagus and admitted during the period from 1925 to June 1941 was 4.3 months (for 66 men 3.5 months, for 29 women 6.0 months).

The duration of life for histologically verified cases was 8.7 months, for unverified cases 7.5 months — in conformity with the principle that only less debilitated patients, have been subjected to esophagoscopy.

An analysis of the number of deaths within the first 3, 6, 9, and 12 months shows that about one third of the patients died within the first three months, one half within the first six months, and almost 80 % within the first year. During the second year another 10 % succumbed. A very essential proportion of the patients who died within the first six months was very debilitated, often almost moribund on admission. These patients received only a few treatments, and most of them died within a month, either in hospital or at home, and the series of patients must therefore be said to have had a very unfavourable composition. In comparison it may be stated that ENGELSTAD (1939) published a report with 65 % deaths within twelve months. In 1940 JENS NIELSEN had also 65 % deaths within the first year, but in a preliminary report on the rotation treatment (1944) his mortality rate had decreased to approximately 50 %, but in the latter series a certain selection had been made. In 1947 FLEMING reported approximately 58 % deaths within the first six months and 80—83 % within the first year.

Of the patients whose treatment was concluded prior to January 1, 1948, seven are still alive (June 1, 1949), thus giving an observation period of at least 17 months. One of these seven patients, a woman, has been free of symptoms for 5 years 10 months following the treatment of a histologically verified basal-cell carcinoma in the middle third of the esophagus; another has been free of symptoms for 4 years 3 months following prickle-cell carcinoma; the others survived 2 years 4 months, 2 years 3 months, 2 years 2 months, 1 year 5 months, and 1 year 4 months, respectively. In four of the last six patients the biopsy was positive for cancer, two cases showing basal-cell, one prickle-cell, and one solid carcinoma. The average duration of life for these seven patients

is thus 2 years 10 months; at the last follow-up examination six of these patients were well and free from recurrence, while one patient has been readmitted with a dubious recurrence.

Table 1

Duration of life exceeding	1 year	2 years	3 years	4 years	5 years
Upper third	20 % (4/21)	10 % (2/21)	0	0	0
Middle third	15 % (10/65)	6 % (4/65)	3 % (2/65)	3 % (2/65)	1½ % (1/65)
Lower third	25 % (19/77)	8 % (6/77)	3 % (2/77)	0	0
Cardia	11 % (6/54)	0	0	0	0

An investigation of the importance of the site of the tumour in the esophagus and cardia shows that there is a wide difference between the duration of life of patients with the tumour localized in the esophagus and that of patients with cancer of the cardio-esophageal junction. Of the latter category only approximately 11 % survived more than one year, while 15—25 % of the patients with esophagus involvement were still alive after that period. All the patients with cancer of the cardiac end of the esophagus died within 2 years (which was also the case in the series reported by JENS NIELSEN) while from 6 to 10 % of the other patients were still alive after that period. Only a few per cent of the esophageal cancer patients were still alive after 3 years. A comparison with the results of the cross-fire therapy during the years 1925—41 shows that by the rotation treatment we have managed to keep twice as many alive for one year as before, and the same applies to two and three years' survivals.

In order to investigate the relation between the roentgen dosage used and the results of the treatment the series has been divided into three groups according to the extent of the treatment.

Group I comprises the patients who have received 4,000 r or less; most of the patients were very desolate cases, in which a few rotation treatments were given, either to comfort the patient or to obtain a certain palliation. Most of these patients died within the first month after hospitalization, either here or in their homes.

Group II comprises the patients who have received from 4,000 to 10,000 r. The dosage was in most instances insufficient, but was not increased either because the patient could not tolerate a larger dose, or did not want to continue the treatment, or because the tumour did not respond.

Group III comprises the patients who in the first course of treatment or in two courses at an interval of less than two months have

received more than 10,000 r. The groups I, II, and III comprise 23, 80, and 111 patients respectively.

An analysis of the localization of the tumour in the esophagus and cardia shows that while 50—60 % of the patients with esophagus involvement were able to complete the treatment, this was the case with only 5 % of the patients with cancer of the cardia; correspondingly only 30—36 % of the esophageal cancer patients are found in Group II, while 2 % of the patients with cancer of the cardia come within this group. Approximately 10 % of the patients are found in Group I, and also here the number of patients with cancer of the cardia is relatively high.

The duration of life within Groups I, II, and III was 1.5, 6.2, and 10.0 months respectively. A comparison of the duration of life of the two sexes separately shows that the average duration of life of female patients was somewhat longer than that of male patients, especially in Group III. While the duration of life in Groups I and II is almost equal whether the tumour is localized somewhere in the esophagus or in the cardia, the duration of life of patients with cancer of the cardiac end in Group III is considerably shorter than that of patients, in whom the tumour involved the upper, middle, or lower thirds of the esophagus — approximately 7 months and 11 months respectively — but, of course, it was essentially longer than that of patients with cancer of the cardiac end of the esophagus in Groups I and II.

With regard to the importance of the histologic composition of the tumour it may be stated that while cases of prickle-cell or basal-cell carcinomas in Group III had an average duration of life of 12—13 months, cases of adenocarcinomas survived for approximately 8½ months only. It must, however, be taken into consideration that most of the adenocarcinomas occurred in the cardiac end of the esophagus.

2) *Palliative Symptomatic Effect.*

It must be realized that the actual curative effect of the rotation therapy has not been very considerable, but nevertheless some prolongation of the average duration of life has been obtained. Moreover, in an evaluation of the rotation therapy the palliative effect must be considered, the more so because the patients presenting themselves for treatment were in a state of general debility and poor nutrition owing to pain and difficulty in swallowing. Previously, the terminal stage of the disease was accompanied by great discomfort for these patients, in whom no curative effect of the therapy could be expected, irrespective of the intensity of the treatment.

Jens Nielsen emphasized the palliative effect as an indisputable therapeutic advance, and we have had ample opportunities of observing this considerable symptomatic effect, the more so because we have

treated all cases admitted to the hospital and endeavoured to give a complete course of treatment, however desolate the patients were.

The immediate effect has been examined, both on the roentgenologic findings and on the individual symptoms, such as pain and difficulty in swallowing.

Effect on the Roentgenologic Findings:

a) Total disappearance of tumour, normal unobstructed passage, normal mucosal pattern ..... 42 patients (20 %)
b) Improved passage, shrinkage of tumour, smoothing of contours, less stricture ..... 96 patients (44 %)
c) Roentgenologically unchanged ..... 28 patients (13 %)
d) Aggravation, tumour increased ..... 6 patients (3 %)
e) No check-up examination because of poor condition of the patients ..... 42 patients (20 %)

Thus it has been possible already at the end of the treatment to make the roentgenologically demonstrable changes disappear completely or regress to a considerable extent in about two thirds of the patients. Some cases showed further improvement at the first follow-up examination two months after the conclusion of the treatment. Group e) comprises the very weak, desolate patients whom we did not want to trouble with an examination after their palliative treatment.

Corresponding to this effect on the roentgenologic changes there was a considerable relief of the patients' difficulty in swallowing. At admission the great majority of the patients were restricted to a liquid diet, and in a not inconsiderable number there was total obstruction.

At discharge after the first hospitalization the conditions were as follows:

a) Unrestricted diet, no difficulty in swallowing ..... 77 patients (35 %)
b) Unrestricted diet, except crusts and unminced meat ..... 26 patients (12 %)
c) Purées ..... 50 patients (23 %)
d) Fluids ..... 60 patients (28 %)
e) Total obstruction ..... 4 patients (2 %)

Two of the patients in group e) had total obstruction till death, which occurred in the course of a few days; the remaining two patients in this group had for some time been fed through a gastrostomy.

Also with regard to swallowing it has been observed that the condition improved further during the first time following the discharge.

Effect on the Pain in Swallowing was excellent. At discharge the conditions were as follows:

a) No pain ..... 131 patients (62 %)
b) Occasional vague pain, a slight burning sensation ..... 14 patients (6 %)
c) Constant pain, fairly unchanged ..... 27 patients (12 %)
d) No information ..... 45 patients (20 %)

General Condition at discharge was:

a) Considerably improved	72 patients	(34 %)
b) Somewhat improved	86 patients	(40 %)
c) Unchanged	27 patients	(12 %)
d) Distinctly deteriorated	29 patients	(13 %)
e) No information	3 patients	(1 %)

Finally, the weight was constantly checked because the patients and their relatives attach much importance to it, but in this respect the improvement was not very conspicuous, most of the patients having lost weight:

a) Weight increased by at least 0.5 kg	21 patients	(10 %)
b) Weight unchanged ($\pm$ 0.5 kg)	28 patients	(13 %)
c) Weight decreased	143 patients	(65 %)
d) No check-up weighing (patients too weak)	25 patient	(12 %)

The average duration of life of the group of patients with total disappearance of the tumour is calculated to be 12.6 months, *i. e.* well over the average for the whole series. Correspondingly, the average duration of life of the patients who had gained in weight during the hospitalization was found to be 13.3 months, *i. e.* considerably over the average of the entire series.

There has thus been a considerable palliative effect of the treatment. In spite of the strain of the heavy irradiation the general condition improved in three out of every four patients; swallowing was improved considerably, and more than one half of the patients were relieved of their pain, although unfortunately most commonly only for varying periods of time. However, numerous cases were observed, in which the patients died from metastases, although locally the tumour had been totally destroyed, both macroscopically and microscopically, for which reason the patients were frequently without any discomforts from the esophagus, apart from the cicatricial stenosal discomfort, which may occasionally be encountered.

The Results of the Rotation Therapy must thus, as far as the curative effect is concerned, be described as fairly modest, since only a few per cent of the patients survive five years free from recurrence, but in comparison with the method of treatment previously employed the average duration of life is doubled, and as far as those patients are concerned that have received the 15,000 r we endeavoured, it is even trebled. One patient with a histologically verified tumour localized in the middle third of the esophagus lives, free of symptoms, 5 years 10 months after the treatment; another patient, also with a histologically verified carcinoma, is alive 4 years after the treatment. Of the patients who were treated prior to January 1, 1948, seven are still alive with an average duration of life of $2^1/_2$ years.

The palliative results of the treatment are far better; the general condition was improved, the pain and difficulty in swallowing were relieved, even though most of the patients lost weight; this symptomatic improvement is of great psychical importance to the patients and lasts in many cases until death due to distant metastases occurs, because the local tumour has been successfully destroyed, but not the glandular or liver metastases.

The rotation treatment of esophageal cancer has thus proved to be of considerable therapeutic value, and judging from the results it may be hoped that a further development of the rotation technique and an increased knowledge of radiobiology in connection with early diagnosis of these cancers, which unfortunately metastasize at a very early phase of the disease, may make it possible also to obtain considerable curative results.

The present work shows that it is possible to make the tumour completely disappear locally in more than 20 % of the cases, while the lasting cures constitute less than 2 %. For this reason it seems to us to be of paramount importance to enlighten the public on these facts in an attempt to reduce the very long time — in this series the average was five months — which often elapses from the onset of the first symptoms till the patients present themselves for treatment. From previous works (KREBS) we know how serious a prolongation of two months of the period from the onset of symptoms to the institution of treatment, *e. g.* for patients with cancer of the cervix uteri, as it appeared that such a prolongation almost halved the number of cases in the first stage and doubled the number of cases in third stage. Principally, it is undoubtedly of paramount importance to induce esophageal cancer patients to present themselves for treatment as early as possible, whether they are to be subjected to surgical procedures or, in a number of cases, to roentgen treatment.

SUMMARY

After a brief review of the theoretical principles and the practical development of the rotation therapy the authors report the results of rotation therapy in 217 cases of cancer of the esophagus and cardia. While the palliative effect has been excellent, the curative effect has not been very considerable, but nevertheless a certain prolongation — in fact almost a doubling — of the average duration of life has been obtained. In more than 20 % of all the patients it has been possible to destroy the tumour locally so that no remnants of malignant tissue were demonstrable even by histologic specimens. However, only a few patients were cured, the rest dying from distant metastases. The cause is to be sought in the long interval which elapses from the onset of symptoms till the patients present themselves for treatment. For this reason it seems to be of paramount importance to enlighten the public on these facts in an attempt to induce the patients with symptoms of esophageal cancer to present themselves for treatment as early as possibly. By shortening the pre-treatment period we have a well-founded hope of being able to obtain far better results.

ZUSAMMENFASSUNG

Nach einer kurzen Besprechung der theoretischen Grundlage und der praktischen Ausformung der Rotationsbehandlung teilen die Verfasser die Resultate der Rotations-

Behandlung von 217 Fällen von Krebs in Oesophagus und Cardia mit. Während die palliative Wirkung hervorragend war, war die kurative Wirkung nur klein; man hat jedoch eine gewisse Verlängerung — praktisch eine Verdoppelung — der durchschnittlichen Lebensdauer erzielt. In mehr als 20 % aller Patienten hat man den Krebs lokal destruiert, so dass auch bei histologischen Untersuchungen keine Spur der bösartigen Tumor zu demonstrieren war. Geheilt sind aber nur ganz wenige Prozente der Patienten, während die übrigen von Fernmetastasen gestorben sind. Der Grund hierzu muss in dem langen Zeitraum (durchschnittlich mehr als 5 Monate) gesucht werden, der von dem Beginn der Symptome bis zu dem Beginn der Behandlung verläuft. Aus diesem Grunde scheint es den Verfassern von grösster Bedeutung, das Publikum über diese Verhältnisse zu informieren, um die Patienten mit Symptomen auf Oesophaguskrebs dazu zu bewegen, sich so früh wie möglich für Behandlung hervorzustellen. Die Verfasser hegen eine wohlgegründete Hoffnung, durch Abkürzung der Periode vor der Behandlung weit bessere kurative Resultate erreichen zu können.

RÉSUMÉ

Après un aperçu des principes théoriques et de la formation pratique de la thérapeutique rotatoire, les auteurs rendent compte de leurs expériences et des résultats obtenus dans 217 cas de cancer de l'œsophage et du cardia, traités par la thérapeutique rotatoire. L'effet palliatif a été eminent mais l'effet curatif considérablement inférieur; pourtant on a obtenu une certaine, assez grande prolongation de la durée moyenne de la vie. Dans plus de 20 pour cent des malades on a détruit la tumeur primaire de sorte qu'aucune trace a été démonstrable même en préparation histologique. Néanmoins seulement un petit nombre des malades a été guéris. Le reste est mort par suite de métastases. La cause en doit être l'intervalle très long (plus de 5 mois en moyenne) qui passe du début des symptômes au commencement du traitement. C'est pourquoi qu'il semble de l'importance la plus grande de persuader les malades avec des symptômes du cancer de l'œsophage de se présenter le plus tôt possible pour le traitement, radiologique ou chirurgical. Par la réduction de l'intervalle du début des symptômes au commencement du traitement, les auteurs croient qu'il est possible d'obtenir une amélioration considérable des résultats curatifs.

REFERENCES

CADE, STANF.: Malignant Disease and its Treatment by Radium. I ed., 1940.
CLAYTON, E. S.: Surg., Gynec. & Obst. 46: 52: 1928.
DESSAUER, F. & G. MUTHEREM: Fortschr. a. d. Geb. d. Rtg. 56: 218: 1937.
DORMANNS, E.: Zeitschr. f. Krebsf. 49: 86: 1939.
ENGELSTAD, R. B.: Acta radiol. 20: 469: 1939.
FLAX, N.: Radiology 28: 477: 1937.
FLEMING, J. A. C.: Brit. J. Radiol. 16: 212: 1943.
—, Thorax 2: 206: 1947.
HENSCHKE, U.: Fortschr. a. d. Geb. d. Rtg. 58: 456: 1938.
KNOX, R. & A. S. G. CAULFIELD: Arch. Rad. & Electr. 20: 176: 1915.
KREBS, CARL: I Krigens Spor. Pt. med C. colli uteri. U. f. L. 103: 406: 1941.
McGIBBON, J. E. G.: Brit. J. Surg. 24: 86: 1936.
MEYER, H.: Z. bl. f. Gyn. 48: 1741: 1913.
NAKAIDZUMI, M. & T. MIYAKAWA: Strahlentherapie 66: 583: 1939.
— & N. MOTIDA: Strahlentherapie 60: 307: 1937.
NEUMANN, W. & F. WACHSMANN: Strahlentherapie 71: 438: 1942.
— & —: Strahlentherapie 75: 323: 1944.

NIELSEN, HOWARD: Acta radiol. 25: 183: 1944.
—, Thesis, Copenhagen 1948.
NIELSEN, JENS: Acta radiol. 21: 352: 1940.
—, Acta radiol. 26: 361: 1945.
ROCHEMONT, R. DU MESNIL DE: Strahlentherapie 60: 648: 1937.
—, Strahlentherapie 63: 176: 1938.
—, Strahlentherapie 66: 593: 1939.
—, Strahlentherapie 68: 221: 1940.
—, Strahlentherapie 69: 407: 1941.
—, Strahlentherapie 72: 121: 1943.
—, Strahlentherapie 75: 35: 1944.

ROM THE ROENTGEN DIAGNOSTIC DEPARTMENT OF KAROLINSKA SJUKHUSET, STOCKHOLM, SWEDEN (CHIEF: PROF. Å. ÅKERLUND)

FURTHER STUDIES WITH VISCOUS UMBRADIL (UMBRADIL-VISKÖS)[1,2]

Its indications and technical application

by

Olallo Morales

In a preliminary report O. MORALES and H. HEIWINKEL (1) described a new roentgen contrast medium, which is viscous, water-soluble, and easily resorbed. It consists mainly of Umbradil (diethanolamine salt of 3,5-diiodo-4-pyridone-N-acetic acid), mixed with a viscosity-increasing substance, carboxymethylcellulose (CMC), as the latter is called in American literature, and corresponds to the German »Natriumsalz von Celluloseglykolsäureäther» (= sodium cellulose glycolate). Many experimental studies have proved this mixture to be innocuous (1). Several other preparations were also tested, among them the recently described Visco-Rayopake (2). This preparation contains polyvinyl alcohol as viscosity-increasing substance. However, it caused such a violent reaction, that further experiments had to be given up.

In spite of its rather high viscosity, the surface tension of Umbradil-Viskös is relatively low, so that it can reach even smaller pockets and very narrow channels, such as the finer branches of the prostatic gland ducts. By spreading rapidly because of its low surface tension it can, furthermore, cover large surfaces, like the mucosa of the trachea. Thus it is entirely superfluous to add a medium that reduces surface tension.

However, it was utmost important to determine how the present contrast medium is being eliminated. Umbradil proper is excreted by the kidneys, as can be seen on roentgen films. By staining histological sections with toluidin blue, B. HELLSTRÖM and HJ. HOLMGREN (3) of Karolinska Institutet showed recently that CMC is taken up by phagocytes within the pulmonary alveoli. Only traces could be found histologically within the phagocytes after three weeks. All histological

[1] Read at the Meeting of the Northern Association for Medical Radiology, Stockholm, June 10—12, 1949; submitted for publication, August 23, 1949.

[2] Umbradil-Viskös is manufactured by A. B. Astra, Södertälje (Sweden).

studies were performed on rats, which received doses 6 to 10 times as high per kg body weight as those used on human beings. HELLSTRÖM and HOLMGREN showed, in experiments performed on animals, that a certain degree of irritation is noticeable, as manifested by an increased amount of fluid within the bronchial tree. This irritation is insignificant and does not leave behind permanent changes which could be proved histologically.

One of the greatest disadvantages of iodized oils is the danger of embolism. This question was studied by injecting different amounts of Umbradil-Viskös into rabbits. It was shown that up to 12—15 ml of the solution could be injected i. v. before a dyspnoea became noticeable, an amount which would correspond to about 200 ml in a human being. Higher doses than these produced death by embolism. It is obvious that such extremely high doses are never used on human beings in clinical examinations and, therefore, no danger of embolism exists.

This highly viscous and water-soluble opaque medium is especially well suited for examinations of the bronchial tree, the male and female sex organs, ducts of different glands and fistular tracts. Because of its high osmotic pressure and the well known specific sensitivity of the meninges against diiodo-pyridone-N-acetic acid, our preparation is not suitable for myelographic studies. There is also no advantage in using this contrast medium in arthrographies.

Experiments, investigations and inquiries among Swedish roentgenologists have shown that, depending on the organs to be examined, three different types of Umbradil-Viskös are required to attain satisfactory diagnostic results: *Umbradil-Viskös B* (for bronchography), *Umbradil-Viskös H* (for hystero-salpingo-pelvigraphy) and *Umbradil-Viskös U* (for urethrography).

The composition of *Umbradil-Viskös B* is: Umbradil 50 %, CMC about 2.70 % (producing a viscosity of 100 Engler degrees or about 600 cst at 37° C),[1] and xylocain 0.5 % (for anaesthesia). The films

[1] The viscosity of a liquid can be measured by its internal friction, or its resistance to flow, in comparison to water as standard (Engler degrees). Nowadays it is expressed in cgs-units. Thus viscosity is defined as the tangential force in dyne per unit area required to move a plane surface at the rate of one centimeter per second against another one when the two surfaces are separated by a layer of liquid one centimeter in thickness. This force is known as the poise — the unit of absolute viscosity. One centipoise (cp) = = 0.01 poise.

Kinematic viscosity is the ratio of absolute viscosity to the specific gravity of the liquid at the temperature, at which the viscosity is measured. The unit is the stoke and viscosity in stokes, multiplied by specific gravity at the test temperature, equals viscosity in poises. One centistoke (cst) = 0.01 stoke.

The measurement of viscosity is made by means of capillary viscosimeters according to Ubbelohde or Vogel-Ossag. One can also use the ball viscosimeter by Höppler.

Case 1.

Man, born 1897 (Pm ktr 97). Since one year tired. Roentgen examination showed a pulmonary tumor within the left tracheo-bronchial angle, which progressed. Bronchographic studies show a pressure defect on the left lower lateral wall of the trachea, on the left main and upper lobe bronchi, possibly caused by a lobular tumor. In addition a defect on the lower wall of the lingular main bronchus is seen.

Diagnosis: Mediastinal tumor, Mb Hodgkin?

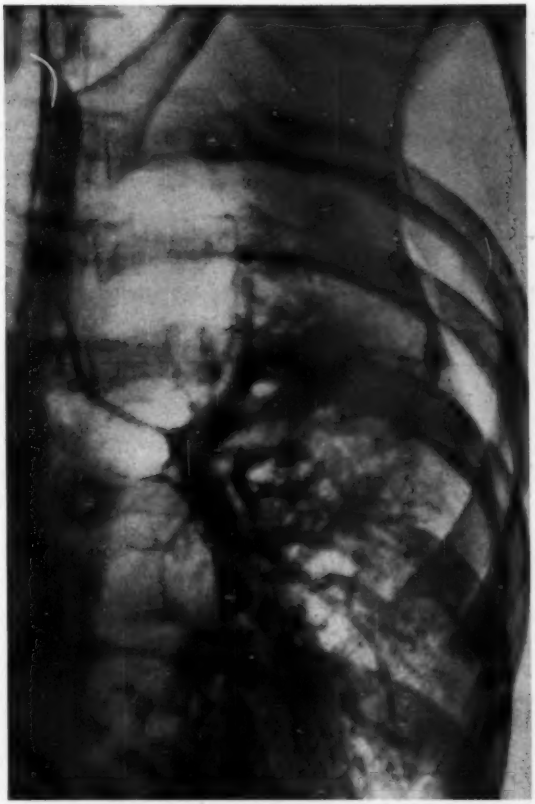
Case 2.

Man, born 1943 (Pm ktr 93). *I. a.* treated for bronchiectasis on several occasions. Bronchographic studies show distinctly cylindrical bronchiectases within the left lower lobe.

Diagnosis: Bronchiectases.

show a thin layer of the opaque medium covering the mucosa of the bronchial tree without clogging the entire lumen. The diagnostic value of bronchographic studies with this medium by far exceeds, therefore, that with iodized oils.

Case 3.



Woman, born 1913 (Pm ktr 124). Thoracoplasty in the left apical parts for pulmonary tuberculosis. Suspicion of bronchiectasis. Bronchographic studies reveal, that the first pectoral bronchus in the upper lobe enters a cavity, the size of a hazelnut, which is filled with opaque medium. A few small similar cavities are visible in the neighbourhood. Small ectases in the bronchial branches in the left upper lobe.

Diagnosis: Cavity in the left upper lobe (tuberculous?) and bronchiectases.

F. K. FISCHER from Zürich, who was visiting Karolinska Sjukhuset at the time our preliminary report (1) was submitted for publication, became very much interested in the bronchographic studies with the new contrast medium. He confirmed our results (4), but he used a contrast medium of a higher viscosity than ours. His films show therefore the

Case 4.

Frontal view.

Woman, born 1907 (Pm ktr 117). Has been treated for pulmonary tuberculosis for several years. Roentgen studies showed a density along the upper portion of the mediastinum, on the right. Bronchographic studies reveal that this density consists of

Case 4 (cont.).

Lateral view.

the entire right upper lobe. The upper lobe bronchus shows strictures and widened sections within the atelectatic lobe, and irregularly defined bronchiectases.

Diagnosis: Tuberculous bronchitis, strictures and ectases in the right upper lobe.

Case 5.

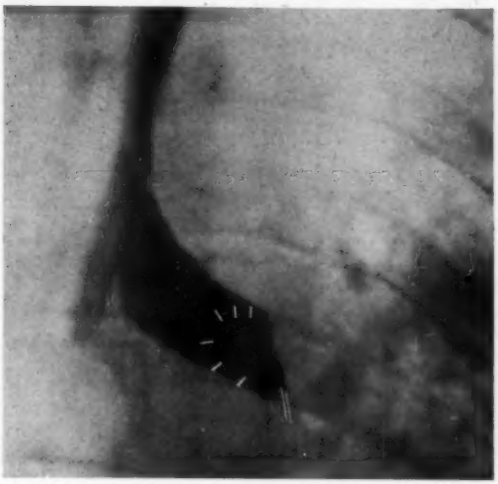
Woman, born 1890 (Pm ktr 122). Hemoptysis half a year ago. Roentgen studies showed a well defined parenchymatous lesion in the right upper lobe. Bronchographic studies reveal a sudden stop of the contrast medium within the apical branch of the right upper lobe.

Diagnosis: Bronchogenic carcinoma.

bronchial tree as silhouettes, similar to those obtained with iodized oils, and no details of the mucosa can be distinguished.

Umbradil-Viskös H, used for hystero-salpingo-pelvigraphy, has a smaller content of Umbradil so as not to obscure details, *e. g.* in the uterine cavity. The viscosity should not be too high in an examination such as pelvigraphy, in order to permit the opaque solution to spread easily within the true pelvis. Xylocain is added to eliminate the cramp-like pains which appear, when the opaque medium is introduced into the uterine cavity and passes through the tubes. Shortly before the examination 200,000 units of penicillin ought to be added against a possible infection, which could be carried into the peritoneal cavity during the process of the examination. As, however, penicillin is being inactivated by the opaque medium and its effectiveness decreases by 10 % within four hours and by 50 % within 24 hours, it cannot be added to the opaque medium at the factory. *Umbradil-Viskös H* therefore contains: Umbradil 25 %, CMC about 2.35 % (corresponding to the viscosity of 40 Engler degrees or about 250 cst at 37°), and xylocain 0.25 %.

Case 6.



Man, born 1888 (Pm ktr 109). Hemoptysis half a year ago. Roentgen studies showed a diffuse density of the left upper lobe. The left main bronchus seemed occluded. Bronchographic studies show a total obliteration of the left main bronchus. A tumor mass, about 1 cm in diameter, protrudes into the bronchial lumen.

Diagnosis: Bronchogenic carcinoma.

The composition of *Umbradil-Viskös U* is: Umbradil 35 %, CMC about 4 % (corresponding to a viscosity of 500 Engler degrees or about 3,500 cst at a temperature of 37° C and showing a consistency of a thick syrup), and xylocain 0.25 %. It fills the lumen of the urethra very well and gives *i. a.* a very good demonstration of the supra-collicular portion. The roentgen studies are mainly used to demonstrate the prostatic portion of the urethra, but the interpretation is rather difficult. R. Romanus of Karolinska Sjukhuset and the author intend to report on their findings shortly in this journal.

For the study of fistulae, for sialographies and mammographies Umbradil-Viskös B is used to good advantage, while Umbradil-Viskös H is more suitable for cholangiographies, in which an increased opacity is not desirable. Because of its viscosity, the opaque medium remains long enough within the ducts to permit the exposure of films after instillation, and the outlines of the ducts appear, therefore, sharply defined.

The *technical procedure in bronchographic studies* with Umbradil-Viskös B differs a little from that used in studies with iodized oils. The

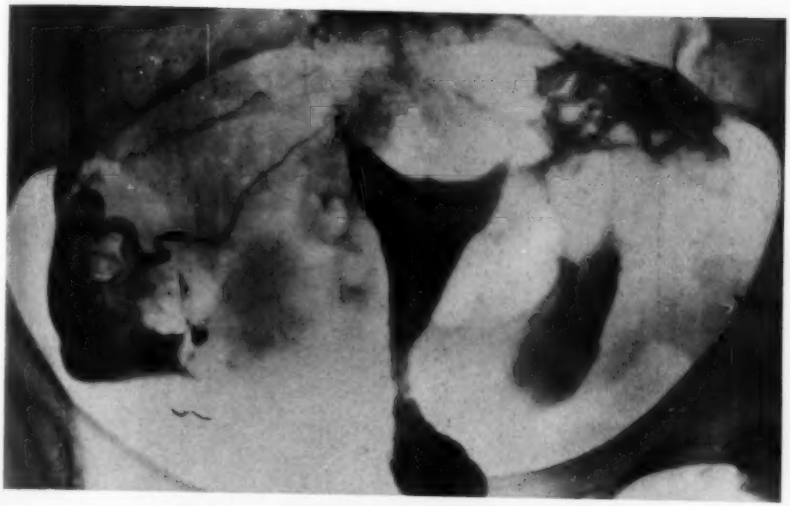
Case 7.

Frontal view at the beginning of the examination.

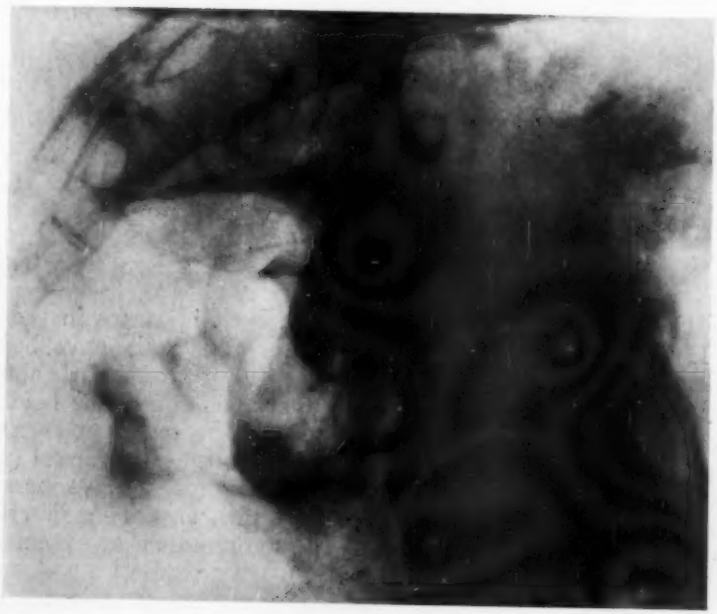
Woman, born 1913 (Hyst n 741). Secondary sterility.
Normal hystero-salpingo-pelvigraphy.

Right oblique view.

Case 7 (cont.).



Left oblique view.



Lateral view.

Case 7 (cont.).

Pat. lying on her left side (frontal view).

preparation for anaesthesia is executed in both instances in the same way. However, as lethal accidents due to anaesthesia have been reported in the literature it is of importance to say a few words about it.

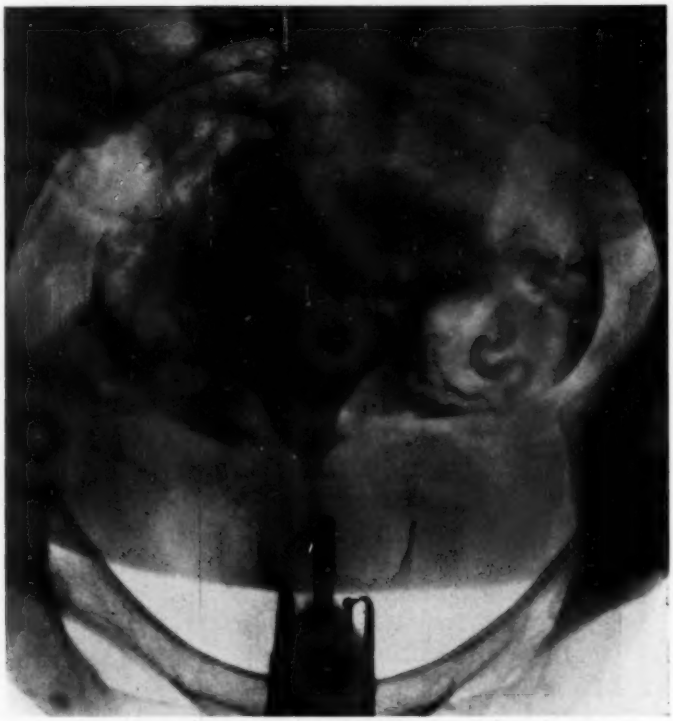
The patient is prepared for anaesthesia about one hour before the beginning of the roentgen examination. Depending on age and sex 7.5 to 15 mg of morphine-scopolamine and 1—2 capsules of nembutal (pentobarbitalsodium à 0.1 g) are administered. Strong men receive more than women, children or old men. Nembutal, which acts immediately and which is quickly excreted, depresses the motor centers and counteracts to a certain degree a possible hypersensitivity to Decicain Astra (= Pantocain). Local anaesthesia is started about 15—20 minutes before

Case 7 (cont.).

Pat. lying on her right side (frontal view).

the bronchographic studies begin. The mouth and throat are sprayed with a 2 % Decicain solution, which contains 4—5 drops of Exadrin (= Adrenalin) 1 : 1,000. Under laryngoscopic guidance the region of the vocal cords is sprayed with a few drops up to about $^1/_2$ ml of this solution while the patient is phonating. After 5—7 minutes a few more ml of the anaesthetizing solution are used, to make the mucosa of the trachea, especially in area of the carina, insensible. The patient is brought into such a position, that the part of the bronchial tree to be examined is at the lowest level (*e. g.* he is turned in oblique prone position with the footend of the table elevated, if the anterior branches of the apical bronchus should be examined). The anaesthetizing solution can thus reach the area to be examined. Deep breathing and slight coughing aid in achieving proper anaesthesia peripherally. A catheter is then in-

Case 7 (cont.).



Pat. half-sitting (axial view).

troduced into the corresponding main bronchus. The entire anaesthesia requires about 4 to 6 ml of a Decicain solution and thus surpasses the official maximum dose ($2^1/_2$ ml). It seems, however, that this procedure is not dangerous, as up to now more than 1,000 cases have been prepared for bronchoscopies and bronchographies in the described manner at Karolinska Sjukhuset, and no serious complications have arisen due to an overdose.

The anaesthesia lasts for one to three hours and therefore certain precautions have to be taken to prevent unpleasant accidents, such as aspiration pneumonia etc. The patient has to remain under supervision for about four hours and he should not be permitted to eat or drink during this time. Since the patient is under the influence of morphine, he has to be watched carefully, a simple warning being insufficient.

Case 8.

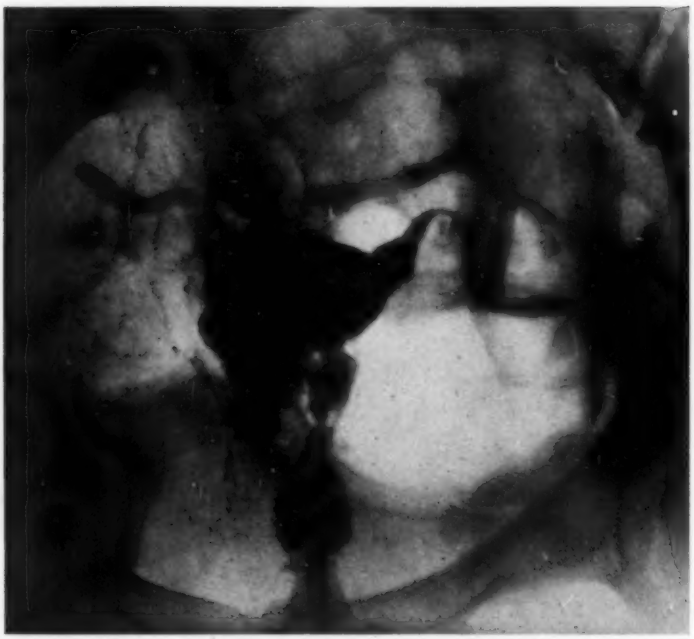
(Compare text.)

Woman, born 1920 (Hyst ε 572). Two years ago resection of the tubes for occlusion with primary sterility. Hystero-salpingo-graphic studies show a cavity within the right uterine wall and a great venous reflux. Several small veins filled with contrast medium. At the intramural part of the right tube a fistula leads into a small cavity and a venous reflux is seen here, too. The stumps of the tubes are also visible. On the last film dye is demonstrable within the urinary bladder.

Another and most serious complication that may occur during anaesthesia is a hypersensitivity reaction to Decicain. This hypersensitivity does not depend on an overdose, although higher doses aggravate the reaction. Dizziness and nausea are its first symptoms and may be followed by convulsions and unconsciousness, resulting finally in death. At the very first signs of hypersensitivity, the administration of the anaesthesia is stopped and oxygen administered immediately. In case of convulsions and unconsciousness Narcotal (Astra) or a similar drug is given intravenously to quiet any cerebral irritation. Stimulants like Tonocard, Pentrozol, Cardiazole and others are contraindicated, as they only aggravate the condition (5).

In order to avoid possible side reactions, caused by Decicain, experiments are now carried out at the Otolaryngologic Department of Karo-

Case 8 (cont.).



More contrast medium injected.

linska Sjukhuset to replace this drug with Xylocain. The results of this investigation will be published in short.

As soon as the anaesthesia is in effect, the bronchographic examination can be started. By means of the catheter the contrast medium is instilled under fluoroscopic observation. It should be injected in small amounts and slowly, as it is intended to cover the mucosa with a thin layer of the opaque medium without clogging the bronchial tubes. Films are taken of small areas with the patient in various positions, as the circumstances require. The beam should be narrowed down as far as possible, and the values of kilovolts and milliampères should correspond to those used for chest film exposures. The film focus distance is, however, not increased. The films should be of the same quality as the plain chest films. The entire lung is in this manner examined step by step. It is advisable to study only one lung at the time, as the procedure is fairly tiresome for the patient.

Case 8 (cont.)

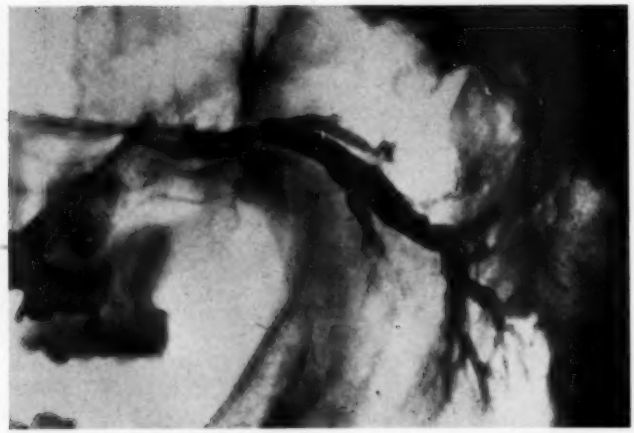
Note contrast medium in the bladder.

The rapid resorption of the contrast medium is of some help during the examination. It can happen that the patient can not avoid coughing in spite of a properly executed anaesthesia. Coughing forces the opaque medium into the alveoli, obscuring thus even larger bronchi in studies performed with iodized oils. Such a complication is avoided with the use of Umbradil-Viskös B, as it is rapidly resorbed within the alveoli. The lung regains its normal appearance 2 hours later.

The only absolute contraindication is the presence of upper respiratory infections, as pneumonia may follow.

The *technique of hystero-salpingo-pelvigraphy* has been worked out in the Roentgen Diagnostic Department of Karolinska Sjukhuset by S. R. KJELLBERG (6). He uses an aqueous contrast medium mixed with novocain. Different concentrations of opaque media are used for hysterosalpingography and pelvigraphy, respectively. The use of this aqueous

Case 9.



Man, born 1886 (Gl ktr 66). One year ago a narrowing of the right parotid duct was revealed. Sialography shows two strictures 1 and 2 cm from the orifice. Distally to the strictures as well as proximally, the duct is widened and irregular up to the smaller branches within the gland.

Case 10.

Man, born 1914 (Gl dil 1). The right parotid duct is widened to ½ cm at the hilus of the gland and for a short distance within the gland proper. There are no signs of stricture. A few normal ducts are filled. Possibly a congenital dilatation of the parotid duct.

olution is of great advantage, although it is hard to demonstrate the avities of the tubes as distinctly as with iodized oils. Some patients how a slight increase in temperature after the examination, in spite f all precautions and the administration of penicillin. In some instances n irritation of the salpinges is observed. All symptoms disappear rapilly, and the temperature returns to normal after a day or two. Sometmes cramplike pains occur during the passage of the contrast medium through the tubes. The administration of Spasmalgin or any other antispasmodic makes it possible to complete the examination successfully without causing discomfort to the patient. Umbradil-Viskös H combines the properties of iodized oils and of the watery contrast medium and permits its easy spreading among the organs in the true pelvis. The above mentioned complications are observed with the use of both contrast media. In neither instance have permanent after-effects been observed. Umbradil-Viskös H, therefore, has been routinely used at the Roentgen Diagnostic Department of Karolinska Sjukhuset during the last two years. In a case of endometriosis (case 8) such a severe venous reflux occurred, that on the last films, about 15 minutes after the beginning of instillation, the opaque solution was demonstrable within the urinary bladder. Clinically there were no signs of any complication, although a fair amount of the viscous contrast substance had reached the veins.

SUMMARY

The author reports on further investigations with the viscous, water-soluble, innocuous contrast media Umbradil-Viskös B, Umbradil-Viskös H, and Umbradil-Viskös U for bronchographies, hystero-salpingo-pelvigraphies and urethrographies respectively, describes the composition and indications, especially with regard to bronchography and hystero-salpingo-pelvigraphy, and gives technical data of these examinations.

ZUSAMMENFASSUNG

Verf. berichtet über weitere Untersuchungen mit den viskösen, wasserlöslichen und unschädlichen Kontrastmitteln Umbradil-Viskös B für Bronchographien, Umbradil-Viskös H für Hystero-Salpingo-Pelvigraphien und Umbradil-Viskös U für Urethrographien; er beschreibt Zusammensetzung und Verwendung dieser Präparate, vor allem hinsichtlich Bronchographie und Hystero-Salpingo-Pelvigraphie und gibt das technische Verfahren bei diesen Untersuchungen an.

RÉSUMÉ

L'auteur communique de nouvelles recherches portant sur les moyens de contraste visqueux, hydrosolubles et à parfaite tolérance que sont l'Umbradil Visqueux B, l'Umbradil Visqueux H et l'Umbradil Visqueux U, convenant respectivement aux bronchographies, aux hystéro-salpingo-pelvigraphies et aux uréthrographies; il décrit leur composition et les indications de leur emploi, particulièrement en ce qui concerne les bronchographies et hystéro-salpingo-pelvigraphies, et apporte les données techniques de ces examens.

LITERATURE

1) Morales, O., and Heiwinkel, H.: A Viscous, Water-Soluble Contrast Preparation. Preliminary Report. Acta Radiol. 30: 257—267, 1948.
2) Rubin, I. C.: New Soluble, Viscous Contrast Medium (Visco-Rayopake, Iodine Preparation) for Hystero-Salpingography. J. Mt. Sinai Hosp. 7: 479—485, 1941.
3) Hellström, B., and Holmgren, Hj.: The Reaction of the Lung on Bronchography with Viscous Umbradil (Umbradil-Viskös), Umbradil (Astra), and Carboxymethylcellulose. In print. (Will be published in Acta Radiol. 32: 5—6.)
4) Fischer, F. K.: Die Darstellung des Bronchialbaumes mit wasserlöslichem Kontrastmittel. Schweiz. med. Wchschr.: 78: 1025—1033, 1948.
5) Gordh, T.: Om giftigheten hos lokalanestetika. Sv. Läkartidn. 43: 1885—1898, 1946.
6) Kjellberg, S. R.: Hystero-Salpingo-Pelvigraphie. Acta Radiol., Suppl. XLIII, 1942.

BIBLIOGRAPHIE DU PROFESSEUR GÖSTA FORSSELL

de Karolinska mediko-kirurgiska institutet, Stockholm

1899—1949

PRÉFACE

En parcourant en 1945 les extraits et les doubles de mes publications, je trouvai qu'il en restait encore au moins 20 exemplaires de 136 publications et que 48 publications en figuraient dans un nombre plus restreint.

Pour empêcher que cette collection ne fût dispersée et pour qu'on pût en tirer le plus grand profit possible, j'arrangeai les écrits par groupes de sujets et les fis relier en trois volumes dont chacun en 20 exemplaires numérotés, qui seraient plus tard distribués à des bibliothèques universitaires scandinaves et étrangères avec lesquelles j'ai eu l'honneur d'avoir des rapports plus intimes.

Pour le groupement de mes extraits et de mes doubles il fut tout d'abord nécessaire de dresser une liste de toutes mes publications, arrangées systématiquement suivant leurs sujets. Voilà comment cette bibliographie a pris forme. La liste chronologique de mes travaux qui fut publiée en 1941 par Elis Berven et Erik Lysholm (L'œuvre du Professeur Gösta Forssell, ouvrages, articles et communications, Acta rad. XXII (1941, pp. 2—10)) m'a servi de base pour la-dite bibliographie. On a ajouté à cette liste des ouvrages déjà parus en 1941 mais qui n'y figuraient pas, ainsi que les travaux qui ont été publiés après cette date jusqu'au mois d'octobre 1949.

Les ouvrages ont été introduits chronologiquement dans chaque groupe de sujets de la bibliographie et pourvus de numéros qui indiquent leurs places dans la série complète de mes publications de 1899 à 1949.

La liste comprend 199 publications, chacune portant son propre numéro. 10 publications qui ont été introduites après le numérotage des extraits ont reçu, pour éviter un renumérotage, le même numéro que l'ouvrage précédent ajouté de bis (61 bis, 96 bis, 106 bis, 135 bis, 178 bis, 179 bis, 187 bis, 190 bis, 195 bis, 197 bis). 209 travaux en tout ont donc été portés sur la liste dont 20 ont paru dans des publications non-périodiques et 189 dans des périodiques et des comptes-rendus. En ce qui concerne les articles parus dans des périodiques ou des comptes-rendus 166 sont des travaux séparés et 23 des remarques au cours de la discussion (29 remarques qui ont été imprimées dans les »Förhandlingar av Nordisk Förening för medicinsk radiologi», ne figurent pas dans cette bibliographie mais se retrouvent dans le »Author index of Vol. I—XXX (1921—1948) and of the Supplements, I—LXXIV of Acta radiologica, Stockholm 1949»).

36 écrits de la bibliographie ont paru de nouveau — éventuellement avec de légères retouches — dans différentes publications et, dans la plupart des cas, en langues différentes. Ces rééditions — au nombre de 51 — sont dans la bibliographie pourvues du même numéro que la première édition avec l'addition d'une petite lettre indiquant chacune une

réédition (par exemple 50 a, 50 b, 50 c, 50 d). Les rééditions comprises, le nombre total des publications de la bibliographie remonte à 260.

Dans la bibliographie 78 travaux qui ne figurent point dans la collection d'extraits sont marqués d'un astérisque sous le numéro de la publication. Certains de ces travaux ont paru dans des publications non-périodiques et ne se prêtent guère, par leur trop grand volume ou format, à être reliés avec les autres. D'autres d'entre eux il n'y a jamais eu d'extraits ou ils sont épuisés.

Les travaux qui ne figurent que dans une partie des volumes de la collection d'extraits sont dans la bibliographie marqués de deux astériques.

La liste des publications des différents groupes de sujets a servi d'index des travaux des différents volumes d'extraits pour indiquer ainsi au lecteur où il retrouvera les travaux de l'auteur qui ne figurent pas dans le volume en question.

Quoique les volumes de la collection d'extraits présentés ici n'aient qu'une étendue assez modeste et qu'ils soient en partie de caractère fragmentaire, ils pourraient offrir un certain intérêt général, car ils comprennent une partie des écrits dans lesquels furent exposés les éléments de la science de l'autoplastique de la muqueuse digestive, ainsi qu'un compte-rendu de l'organisation de la lutte en Suède contre le cancer, de l'organisation du service médical et de l'enseignement dans le domaine de la radiologie et des projets de la création de l'Hôpital Universitaire de Stockholm, le »Karolinska sjukhuset».

Une trentaine de courtes biographies d'éminents radiologues des 25 dernières années offrent pour ainsi dire une vue d'ensemble sur l'histoire de la radiologie médicale pendant cette période.

L'étendue relativement modeste de cette production scientifique d'un demi-siècle s'explique, au moins partiellement, par le fait que la plus grande partie de l'activité de l'auteur a été vouée à sa tâche de médecin, de professeur et d'organisateur. La majeure partie de son travail scientifique a été accomplie pendant la nuit après un long jour de travail au service de la radiologie pratique.

La nomenclature qui a été adoptée pour la science des rayons et ses branches dans cette bibliographie répond à celle qui est utilisée en général dans les ouvrages allemands et dans la plus grande partie des ouvrages américains et scandinaves.

Toute la science du rayonnement (radiation, Strahlung) dans toute ses formes est dénommée du terme collectif radiologie (radiology, Radiologie).

La radiologie au service médical s'appelle ici radiologie médicale (medical radiology, medizinische Radiologie).

Dans la radiologie nous distinguons trois subdivisions: la science de la lumière (science of the light, Wissenschaft der Lichtstrahlen); la science des rayons rœntgen, la rœntgenologie (roentgenology, Röntgenologie), et la science de la radio-activité de la matière [des corps radio-actifs] (science of radiant substances, Wissenschaft der strahlenden Stoffe).

L'emploi des rayons pour le diagnostic est collectivement appelé radiodiagnostic (radiodiagnostics, Radiodiagnostik) tandis que la radiothérapie (radiotherapy ou radiation therapy, Strahlentherapie) signifie l'emploi des rayons pour le traitement des malades.

L'emploi de la lumière pour des observations (photodiagnostic) s'opère soit en observant l'objet exposé à la lumière, procédé dénommé différemment suivant les divers terrains et techniques de recherches comme macro- et microscopie, ainsi qu'endoscopie, soit par des reproductions au moyen de la lumière, photographie.

L'usage de lumière naturelle ou artificielle pour le traitement des malades s'appelle photothérapie ou héliothérapie, à quoi on ajoute un terme spécial pour les différentes formes de lumière (longueur d'ondes) ou se référant aux appareils dont on s'est servi, comme thérapie ultra-violette, thérapie rouge, thérapie Finsen, etc.

Les rayons découverts et décrits pour la première fois par C. W. Röntgen sont ici appelés rayons rœntgen (roentgen rays, Röntgenstrahlen). La dénomination »rayons rœntgen» a été abrégée dans les termes et les expressions plus complexes, où elle a été remplacée par »rœntgen» tout court suivant la nomenclature conçue déjà au premier congrès rœntgenologique allemand (1905) et conformément à la décision du second congrès international de radiologie (1928) d'appeler l'unité de la quantité internationale du rayonnement rœntgen, »the roentgen».

On abrège encore assez souvent, pour des raisons d'espace, le terme rœntgen- ou rœntgeno- en »rœ» (»rö»), comme par exemple »rœ-diagnostic», »rœ-exam.».

La science de l'examen au moyen des rayons rœntgen s'appelle rœntgendiagnostic (roentgendiagnostics, Röntgenuntersuchung). Le terme diagnose rœntgenologique (roentgendiagnosis) s'emploi également dans ce sens plus général mais désignait originairement et au sens propre du mot l'acte de faire le diagnostic d'une maladie à l'aide des rayons rœntgen. Il conviendrait de réserver au mot ce sens plus limité.

Les termes du rœntgendiagnostic les plus courants sont donc ceux-ci: rœntgenographie (roentgenography, Röntgenaufnahme); rœntgenogramme (roentgenogram, Röntgenogram); ortho-rœntgenographie, télé-rœntgenographie, micro-rœntgenographie, rœntgenoscopie (roentgenoscopy, Röntgenoskopie).

La science du traitement avec les rayons rœntgen s'appelle rœntgenothérapie (roentgentherapy, Röntgentherapie) dont les différentes formes sont dénommées ou d'après les longueurs d'ondes (degré de dureté) des rayons en question comme par exemple rœntgenthérapie superficielle, sémipénétrante, pénétrante et ultrapénétrante ou d'après la technique utilisée, comme télé-rœntgenthérapie et rœntgenthérapie de contact.

Pour l'emploi des »corps radio-actifs» ou de la »radio-activité de la matière», il n'existe pas, en fait de traitement, de terme collectif généralement admis. Dans la littérature française »curiethérapie» sert de terme collectif pour le traitement avec matière radioactive. En même temps et plus souvent on emploie pourtant le terme »curiethérapie» comme synonyme de »radiumthérapie» ce qui cause dans cette nomenclature une certaine confusion. Il semble pratique d'utiliser, comme on le fait dans la plupart des cas, pour la description de ce traitement le nom du corps radio-actif dont on se sert dans le cas en question, par exemple »radiumthérapie», »mésothoriumthérapie», etc., en ajoutant un complément indiquant la technique.

La plus grande partie de la littérature française et anglaise diffère de la nomenclature adoptée ici principalement par le fait qu'on a supprimé le nom de Röntgen dans le terme désignant les rayons qu'il a découverts. Il importe moins qu'on ait gardé le terme »rayons X», que Röntgen lui-même attribua à ces nouveaux rayons avant que leur nature ne fût encore expliquée. On comprend très bien la signification des »rayons X» quoique ce terme périmé s'emploie assez souvent alternativement avec »rayons rœntgen» dans la même publication. Il est par contre équivoque et prêtant à confusion d'utiliser pour »rœntgenologie» le même terme, »radiologie» (radiology), que pour la science radiologique entière, ainsi que »radiothérapie» (radiotherapy) désignant alternativement toute la science du traitement radiologique et le traitement avec les rayons rœntgen. Il est également inadéquat d'employer pour »rœntgendiagnostic» le terme »radiodiagnostic» (radiodiagnostics) pour ne pas parler de la combinaison »diagnostic radiology», difformité linguistique et réelle, quand il s'agit en effet de »roentgendiagnostics» et de rien d'autre.

Il est indispensable dans la littérature scientifique que les définitions et les termes soient formulés par-dessus tout en considération de la clarté et de l'exactitude. Les égards pour les coutumes de la langue qui se sont imposées sont une chose de second lieu surtout quand il s'agit de la langue française, modèle de toute exposition scientifique.

Quoique la biliographie soit écrite en français, j'ai donc osé rompre avec l'usage français dans certaines parties de la radiologie en employant une terminologie que j'ai trouvé plus appropriée et dont se sont également servis certains auteurs français.

Je tiens à remercier bien sincèrement M. Harald Bohrn, bibliothécaire à la Bibliothèque Royale de Stockholm, et M^me^ Gurli Grundström, Djursholm, pour l'adresse et l'intérêt qu'ils ont portés à l'accomplissement de cette bibliographie.

Djursholm en octobre 1949

Gösta Forssell.

LISTE DES PUBLICATIONS

I. ANATOMIE ET PHYSIOLOGIE

I A. Anatomie générale et mouvements de l'estomac, spécialement au point de vue rœntgenologique

23. Canalis pylori å röntgenbilder. (Le canal pylorique sur les rœntgenogrammes.) Hygiea 72 (1910), 572—580.

24. Die Ventrikelnomenklatur in Beleuchtung der röntgenologischen Forschung. * Congr. Internat. Radiol. et Electr., Bruxelles 1910, Compte rendu. Tome II, 321—322.

28. Ventrikelrörelserna hos människan. En röntgenologisk studie. (Les mouvements de l'estomac humain. Une étude rœntgenologique.) Nord. med. ark. 44 (1911), Festskr. f. J. Berg, Avd. 1, nr 36, 1—64.

29. Bidrag till gastroptosfrågan. (Contribution à la connaissance de la ptose gastrique.) * Remarques au cours de la discussion. Nord. kirurg. fören. förh. 1911, 162—165.

34 a. Les rapports entre les formes radiologiques de l'estomac humain et l'architecture musculaire de la paroi stomacale. Arch. électr. méd. 20: 1 (1912), 529—549.

34 b. Über die Beziehung der auf den Röntgenbildern hervortretenden Formen des menschlichen Magens zur Muskelarchitektur der Magenwand. Münch. med. Wschr. 59: 2 (1912), 1588—1592.

34 c. Über die auf den Röntgenbildern hervortretenden Formen des menschlichen Magens und die Muskelarchitektur der Magenwand. Verh. dtsch. Rö. Ges. 7 (1912), 37—38.

37. Über die Beziehung der Röntgenbilder des menschlichen Magens zu seinem anatomischen Bau. * Beiträge zur Anatomie und Physiologie des Magens. Fschr. Röntgenstr., Erg. bd 30 (1913), 1—265.

39. Bandagebehandling vid gastroptos. (Traitement par bandage de la ptose gastrique.) Remarques au cours de la discussion. Allm. sv. läkartidn. 11 (1914), 452—457.

56. Om ventrikelns nervapparat och ulcus curvaturae minoris. (Sur le système nerveux de l'estomac et Ulcus curvaturae minoris.) * Remarques au cours de la discussion. Sv. läk. sällsk. förh. 1919, 102—103.

59. Gastro-entero-anastomosens funktion vid den kirurgiska behandlingen av ulcus ventr. et duodeni. * (La fonction de la gastro-entéro-anastomose dans le traitement chirurgical de l'ulcus ventr. et duodeni.) Remarques au cours de la discussion. Acta chir. 52 (1920), 392.

70. Relation between the shape of the chest and the shape and position of the stomach. Remarques au cours de la discussion. Acta med. scand. Suppl. 3 (1922), 193—195.

131. Pylorospasmens patogenes. (La pathogenèse du spasme pylorique des nourrissons.) Remarques au cours de la discussion. Sv. läk. sällsk. förh. 1932, 78—82.

173. Kongenitala pylorusstenosen. (La sténose pylorique congénitale.) Remarques au cours de la discussion. Nord. med. 8 (1940), 1849.

---

* *Non présenté dans la Collection d'extraits.*

** *Présenté seulement dans une part des Volumes d'extraits.*

I B. Morphologie et mouvements de la muqueuse digestive

37. Über die Beziehung der Röntgenbilder des menschlichen Magens zu seinem ana-
* tomischen Bau. Beiträge zur Anatomie und Physiologie des Magens. Kap. VIII: 3 Über die Form des Magenlumens und die dafür bestimmenden Bildungen der Magenwand. Fschr. Röntgenstr., Erg.bd 30 (1913), 129—151. Voir I A.

65. Studies of the mechanism of movement of the mucous membrane in the digestive canal. Acta rad. 1 (1922), 511—512.

67. Röntgenologie des Magens und Darms. Leitfaden der Röntgenologie, hrsg. H.
** Gerhartz, Berlin 1922, p. 87—88, 92; 112; 117; 121.

68. Beobachtungen über die Bewegungen der Schleimhaut des Digestionskanales. Verh. dtsch. Röntgen-Ges. 13 (1922), 54—55.

69. Études sur les reliefs de la muqueuse du tube digestif. Remarques au cours de la discussion. Acta med. scand. Suppl. 3 (1922), 154—159.

75. Studies of the mechanism of movement of the mucous membrane of the digestive tract. Amer. j. roentgenol. 10 (1923), 87—104.

76. The movements of the gastro-intestinal mucosa. The Lancet 1 (1923), 648—
* 650.

77. The anatomical basis of the deformity of the duodenal bulb in duodenal ulcer. Acta rad. 3 (1924), 217—221. Remarques au cours de la discussion à C. I. Baastrup, Methods for obtaining pictures of the mucous membrane of the stomach.

78. Autoplastic of the intestinal mucous membrane. Ibidem, p. 223—226.

79. Rörelserna hos slemhinnan i digestionskanalen och deras betydelse för digestionsmekanismen. (Les mouvements de la muqueuse du canal digestif et leur rôle dans le mécanisme de la digestion.) Allm. sv. läkartidn. 1924, 41—43.

89. Die Bewegungsvorgänge der Schleimhaut des Magen-Darmkanales. Fschr. Röntgenstr. 33 (1925). Verh. d. deut. Rö. Ges. 16 (1925), 4—8.

98 a. Normale und pathologische Reliefbilder der Schleimhaut. Verh. Ges. Verdgskrkh., VII. Tagung in Wien 1927, Verlag Thieme 1928. p. 199—219.

98 b. *Traduction en anglais dans* »Radiological exploration of the mucosa of the gastro-
* intestinal tract» by Cole collaborators. St. Paul and Philadelphia 1934, 275—323.

98 c. Über normale und pathologische Reliefbilder der Schleimhaut. Die med. Welt.
* Kongr. Ber. 1927, 18—19.

113. Beobachtungen über die Autoplastik des Digestionskanales. Fschr. Röntgenstr. 37 (1928), 393—394.

131. Pylorospasmens patogenes. (La pathogenèse du spasme pylorique des nourrissons. Remarques au cours de la discussion. Sv. läk. sällsk. förh. 1932, p. 78—82. Voir I A.

136. Beiträge zur Kenntnis des Bewegungsmechanismus der Schleimhaut. Rieder-Vorlesung. Fschr. Röntgenstr. 50 (1934), Kongr. H. 1—5.

139. Beobachtungen über die Schleimhautfaltenbildung des Magens. (Résumé.) IV. Internat, Radiol. Kongr. Zürich, Bd 2, (1934), 258—260.

142. Blick in die Werkstatt des Verdauungskanals. Neue Zürcher Zeitung 25. 7.
* 1934.

149. Ein Beitrag zur Kenntnis der Verteilung der Arterien der Submukosa und der Mukosa des Magens im Verhältnis zum Schleimhautrelief. Fschr. Röntgenstr. 51 (1935), 338—341.

154. Gastroskopiska iakttagelser särskilt med hänsyn till slemhinnereliefen. (Observations gastroscopiques surtout au point de vue du relief de la muqueuse.) Remarques au cours de la discussion. Nord. med. tskr. 13 (1937), 710—711.

162. Die Aufgabe der autonomen Schleimhautbewegungen bei der Verdauung. Fschr.
** Röntgenstr. 57 (1938), 331—353.

163. The rôle of the autonomous movements of the gastrointestinal mucous membrane in digestion. Amer. j. roentgenol. 41 (1939), 145—165.

173. Kongenitala pylorusstenosen. (La sténose pylorique congénitale.) Remarques au cours de la discussion. Nord. med. 8. (1940), 1849. Voir 1 A.

177. Matsmältningskanalens mekaniska verkstad. (L'atelier mécanique de la digestion.)
* Veckojournalen 1941, nr 9.

179. Om rörelsemekanismen hos digestionskanalens slemhinna. Professor Gösta Fors-
* sells andra avskedsföreläsning d. 29 mars 1941. (Sur le mécanisme du mouvement de la muqueuse digestive. Seconde conférence d'adieu du prof. Gösta Forssell, le 29 mars, 1941.) Résumé dans Med. fören. tskr. 1941, 91.

179 bis. Avskedshälsning till studenterna, 29. 3. 41. (Salut d'adieu aux étudiants le
* 29. 3. 41.)

I C. Branches diverses de l'anatomie

1. Beiträge zur Kenntnis der Anatomie der Lorenzini'schen Ampulle bei Acanthias
** vulgaris. Z. wiss. Zool. 45 (1899), 725—744.

2. Über die Bewegungen im Handgelenke des Menschen. Eine röntgenographische
** Studie. Skand. Arch. Physiol. 12 (1901) 168—258.

9 a. Några ord om bäckenets röntgenanatomi särskilt med hänsyn till förkalkningar i
** kärlen såsom felkälla vid diagnos av sten i urinapparaten. (Quelques mots sur l'anatomie rœntgenologique du bassin particulièrement à l'égard des calcifications des vaisseaux comme sources d'erreur dans le diagnostic des calculs des voies urinaires.) Sv. läk. sällsk. förh. 1908, 33—45.

9 b. Autoreferat in Fortschr. a. d. Geb. d. Rö.strahlen. Bd 13, 51.
*

15. Rippenrudimente der Lendenwirbelsäule als Fehlerquelle bei der Diagnose von
* Frakturen der Querfortsätze. Fschr. Röntgenstr. 12 (1908), 174—175.

51. Redogörelse för röntgenundersökning av Konung Karl XII:s huvud d. 18, 19,
* 21 och 24 juli 1917. (Rapport sur l'examen rœntgenologique du crâne de Charles XII.) Konung Karl XII:s banesår. P. A. Norstedt & Söner, Stockholm 1918, 82—96.

52. Redogörelse för röntgenundersökningen av Konung Karl XII:s benbrott och skott-
* skadan i vänstra foten den 24 och 27 juli 1917. (Rapport sur l'examen rœntgenologique des fractures ainsi que de la blessure par balle du pied gauche de Charles XII.) Konung Karl XII:s banesår. P. A. Norstedt & Söner, Stockholm 1918, 124—125.

135. A contribution to the roentgenologic anatomy of the urinary bladder. Acta rad.
* 18 (1937), 509—511.

II. RŒNTGENDIAGNOSTIC

II A. Anatomie et pathologie rœntgenologiques

6. Beitrag zu der Untersuchung von Prof. J. Berg: Über die Bedeutung der Röntgenographie für die Diagnose und Behandlung der Blasensteine. Nord. med. ark. 1907, Avd. I. H. 3 & 4. Nr 9.

13. (En collaboration avec C. D. Josephson.) Bidrag till röntgendiagnostiken vid njurtuberkulos. (Contribution au rœntgendiagnostic de la tuberculose rénale.) Hygiea Festbd 1908, Nr 34, 20 p.

17 a. Über die Radiologie der endogenen Prostatakonkremente. Verh. dtsch. Röntgen-Ges. 5 (1909), 112—114.

17 b. Ueber die Röntgenologie der endogenen Prostatakonkremente. Münch. med. Wschr. 56: 1 (1909), 1176—1177.

17 c. Om de endogena prostatakonkrementens röntgenologi. Sv. läk. sällsk. förh. 1908, 438—442.

18. Om röntgendiagnosen av tuberkulos i bensystemet med särskild hänsyn till den tuberkulösa coxiten. (Sur le rœntgendiagnostic de la tuberculose du squelette particulièrement au sujet de la coxalgie tuberculeuse.) Sv. läk. sällsk. förh. 1909, 258—286.

32. Pathologische Reizung des Knochenwachstums als röntgenologisches Symptom bei Fungus jugendlicher Individuen. Remarques au cours de la discussion. Verh. dtsch. Röntgen-Ges. 7 (1912), 37—38.

35. Über die Köhler'sche Erkrankung des Os naviculare pedis. Remarques au cours de la discussion. Verh. dtsch. Röntgen-Ges. 8 (1912), 37—38.

42 a. (En collaboration avec E. Key.) Ein Divertikel an der Pars descendens duodeni mittels Röntgenuntersuchung diagnostiziert und operativ entfernt. Fschr. Röntgenstr. 24 (1916/17), 48—57.

42 b. Divertikel å pars descendens duodeni diagnosticeradt medels röntgenundersökning och operativt aflägsnadt. Nord. med. ark. 48 (1915), Avd. II. H. 1. Nr 2, 1—21.

46 a. Om röntgenundersökningens betydelse för ben- och ledgångstuberkulosens diagnostik. (Sur l'importance de l'examen rœntgenologique pour le diagnostic de la tuberculose osseuse et articulaire.) Förhandl. Nord. kir. fören:s 11:e möte, Göteborg 1916, Avd. III, 1—22.

46 b. Tskr. Norske Laegeforen. 1916, Nr 22—23.

47. Några ord om röntgendiagnostiken vid ben- och ledtuberkulos. (Quelques mots sur le rœntgendiagnostic de la tuberculose osseuse et articulaire.) Sv. läk. sällsk. handl. 42 (1916), 746—764.

55. Om röntgendiagnostiken av förändringar i blindtarmens bihang. (Le rœntgendiagnostic des altérations de l'appendice.) Sv. läk. sällsk. förh. 1918, 4—28.

58. Några synpunkter vid bedömande av ulcusnischer å röntgenbilder. (Quelques points de vue sur l'interprétation des niches ulcéreuses d'après les rœntgenographies.) Sv. läk. sällsk. förh. 1919, 385—388.

60. A few notes on the diagnosis and differential diagnosis of tuberculosis in bones and joints. Arch. radiol. a. electrother. 25 (1920/21), 257—271, 293—310.

63. Roentgenological diagnostics of changes in the appendix and caecum. Remarques
* au cours de la discussion. Acta rad. 1 (1922), 489—490, 493.

66. Röntgenundersökningens betydelse vid första behandlingen av skottskador under krig. (L'importance de l'examen rœntgenologique pour le traitement immédiat des blessures de guerre.) Remarques au cours de la discussion. Sv. läk. sällsk. förh. 1922, 296—301.

67. Röntgenologie des Magens und Darms. Leitfaden der Röntgenologie, hrsg. H. Ger-
** hartz, Berlin 1922, 81—128. Voir I B.

78. A contribution to the roentgenological diagnosis of the ulcus pepticum jejuni. Remarques au cours de la discussion. Acta rad. 3 (1924), 223—226.

96. bis. On the roentgenanatomy of the lungs, spec. on the »hilum shadow». Discussional remarks. Acta rad. VIII (1927), 625—626.

134. Röntgenologisk diagnos och differentialdiagnos vid cancer coli. (Diagnostic rœntgenologique et différentiel du cancer du colon.) Remarques au cours de la discussion. Förhandl. Nord. kir. fören:s 19:e möte. Stockholm 1933, 242.

169. Förord till G. Claessen, Röntgendiagnostik. (Préface à G. Claessen, Röntgen-
* diagnostik.) Köbenhavn 1940, 11—15. 2ème éd. 1946, xi—xv.

II B. Technique du rœntgendiagnostic

7. Några nya anordningar för röntgenografering i omedelbar anslutning till genomlysning vid Holzknechts vertikala genomlysningsapparat och för en säkrare ortodiagrafering med denna apparat. (Quelques dispositifs nouveaux pour la rœntgenographie combinée avec la rœntgenoscopie en utilisant l'appareil vertical de rœntgenoscopie de Holzknecht et pour permettre une orthodiagraphie plus sûre avec cet appareil.) Sv. läk. sällsk. förh. 1908, 7—13.

8 a. Apparat för belysning av röntgenogram med indirekt ljus. (Un négatoscope à lumière indirecte.) Sv. läk. sällsk. förh., Hygiea 1908, 13. Voir II B. 7.

8 b. Ein neuer Schaukasten für Röntgenogramme mit indirekter Beleuchtung. Verh.
** d. Deutsch. Rö. Ges. 4 (1908), 158—159.

8 c. Neuer Betrachtungskasten nach dr Forssell. Katalog von R. Seifert & Co., Ham-
** burg 1908, 1 p.

8 d. Un négatoscope pour salles de démonstration. Arch. d'él. méd. 1910, Nr 294,
* 811.

14 a. Einige Vorrichtungen zur Röntgenographierung mit Kompression und Orthodiagraphierung in unmittelbarem Anschluss an die Durchleuchtung. Fschr. Röntgenstr. 12, (1908), 109—115.

14 b. Apparat zur Röntgenographie und Orthodiagraphie in unmittelbarem Anschluss
** an die Durchleuchtung. Katalog von R. Seifert & Co., Hamburg 1909, 1 p.

20 a. Ein für Röntgenplatten sehr geeigneter Uranverstärker. Fschr. Röntgenstr. 14
** (1909/10), 419—422.

20 b. En för röntgenplåtar lämplig uranförstärkare. Allm. sv. läkartidn. 6 (1909), 977—
** 981.

20 c. Analyse dans Arch. électr. méd. 18 (1910), 580—581.

27. Om de tekniska erfarenheterna vid röntgenundersökning av lungorna. (Expérience
* de la technique de l'examen des poumons par les rayons rœntgen.) Remarque au cours de la discussion. Sv. läk. sällsk. förh. 1910, 383.

33. Das Telephon und das Diktaphon im Dienste der Röntgenologie. Z. Röntgenk 14 (1912), 351—352.

61 bis. A plateholder for precise roentgenography in connection with fluoroscopy. Act rad. 1 (1921) 48—50.

81. Barium porcelain; a new protective material against the roentgen rays. Acta rad.
* 3 (1924), 249.

III. LUTTE CONTRE LE CANCER

III A. Organisation de la lutte contre le cancer

101 a. Mål och medel i kampen mot kräftsjukdomarna. (Buts et moyens dans la lutte
** contre le cancer.) Flygblad 16 maj 1928. (Feuille volante, le 16 mai, 1928.)

101 b. Mål och medel i kampen mot kräftsjukdomarna. Hyg. revy. 17 (1928), 83—
* 86.

102. Kräftsjukdomarna och deras bekämpande. Radioföredrag den 16 maj 1928. (Les
* maladies cancéreuses et les moyens de les combattre. Conférence à la T. S. F.) Nya Dagl. Allehanda d. 17 maj 1928.

106. Die radiotherapeutische Klinik des Kanzervereins in Stockholm, »Radiumhemmet», ihre Organisation, Arbeitsmethoden und Behandlungsresultate. Acta rad. 9 (1928), 315—363.

106 bis. Verzeichnis der am Radiumhemmet in den Jahren 1910—1928 publizierten
* Arbeiten. Acta rad. 9 (1928), 364—369.

110. Review of the organisation and the work at »Radiumhemmet» in Stockholm. »Euro-
* pean Clinics», edited by W. Lintz, Philadelphia & London 1928.

111. Nationalgåvan på Konung Gustaf V:s 70-årsdag och dess betydelse för kampen mot
* kräftsjukdomarna i Sverige. (Le don national à l'occasion du 70e anniversaire de S. M. le Roi Gustave V et son importance pour la lutte contre le cancer en Suède.) Med folket för fosterlandet, Bd 1, Stockholm 1938, 263—270.

112 a. Kräftsjukdomarna och deras bekämpande. (Les maladies cancéreuses et les moyens
* de les combattre.) Almanack för alla 1929, 165—170.

112 b. Almanackan 1930, 22—29.

114 a. Radiotherapy of malignant tumours in Sweden. Mackenzie-Davidson memorial lecture. Dec. 4th, 1929, Brit. j. radiol., N. ser. 3 (1930), 198—234.

114 b. Strahlentherapie maligner Tumoren in Schweden, mit besonderer Berücksichtigung der Erfahrungen des Radiumhemmets. Strahlenther. 37 (1930), 215—253.

114 c. Radium and cancer. Med. press. 128 (1929), 517—518.
*

119. Strahlentherapie maligner Tumoren in Schweden. Wien. klin. Wschr. 43 (1930), 1161—1165, 1194—1196.

26 a. La lutte sociale contre le cancer. J. radiol. et electrol. 15 (1931), 621—634.
26 b. The campaign of society against cancer. Amer. j. canc. 20 (1934), 848—865.
26 c. Rapports sur les questions à l'ordre du jour du III:e Congrès internat. de * radiologie, Paris, 1931, 60—82.

29 a. Die Organisation der Krebsbekämpfung in Schweden. Dtsch. med. Wschr. 58 (1932), 359—363.
129 b. Sveriges org. av kampen mot kräftsjukd. Nord. med. tskr. 4 (1932). 241—251.

132 a. Sweden's anti-cancer campaign. Acta rad. 13 (1932), 295—318.
132 b. Amer. j. canc. 20 (1934), 866—882.
*

140. Die Organisation der Krebsbekämpfung in Schweden. IV. Internat. Radiol. Kongr. Zürich, Bd 3 (1934), 27—48.

141 a. Die Grundlagen der Organisation der Krebsbekämpfung in Schweden. IV. Internat. Radiol. Kongr. Zürich Bd 4 (1934), 56—63.
141 b. Die Grundlagen der Organisation der Krebsbekämpfung. Schweiz. med. Wschr. 15 (1934), 977—979.

144. Über die Organisation der Krebsbekämpfung. Acta rad. 16 (1935), 99—128.

152. La lutte contre le cancer en Suède. II[e] Congrès internat. de lutte scientifique et sociale contre le cancer. Communications. Bruxelles 1936: 2, 525—528.

153. Le fonds du Jubilé de S. M. le Roi Gustave V pour la lutte contre le cancer. L'Opinion publique, Journal hebdomadaire de la Ligue nationale belge contre le cancer, 5 (1937), No. 13, 3.

157. Les lignes fondamentales de l'organisation de la lutte contre le cancer. Conférence faite à Bruxelles le 25 mars 1935 à l'occasion du X[ème] anniversaire de la fondation de la Ligue nationale belge contre le cancer. Bruges 1937, 11—29.

184. Konung Gustaf V och medicinen. (Le Roi Gustave V et la médecine.) Minnesskriften »Vår konung» 1858 16/6 1943 utg. med anledning av H. M. Konung Gustafs 35-åriga regering och hans 85-årsdag. Lindfors, Sthlm 1943, 215—261.

III B. Radiothérapie

3. Kort översikt över nyare rön inom röntgenterapien. (Bref aperçu des dernières expériences dans le domaine de la rœntgenthérapie.) Allm. sv. läkartidn. 1 (1904), 481—498, 502—509.

19. Ett efter expeditiv röntgenbehandling läkt fall av djupgående hudkräfta. (Un cas de cancer profond de la peau guéri par la rœntgenthérapie expéditive.) Sv. läk. sällsk. förh. 1909, 299—301.

2[2] a. Om röntgenbehandling av hudkräfta. (Sur la rœntgenthérapie du cancer de la peau.) Förhandl. Nord. kir. fören:s 8:e möte i Hfors, Lund 1909, Avd. III, 65—71.
2[2] b. Om röntgenbehandling af hudkräfta. Nord. Tskr. Ter. 7 (1908/09), 340—352.

2[5] a. Quelques expériences de la radiumthérapie des tumeurs cancéreuses. Congr. * Internat. Radiol. et Electr., Bruxelles 1910. Compte rendu, Tome II, 343—346.
2[5] b. Travaux de la II:e confér. intern. pour l'étude du cancer à Paris, oct. 1910. *
2[5] c. Analyse dans Arch. électr. méd. 18 (1910), 801—802. *

30. Radiumbehandling av maligna tumörer i kvinnliga genitalia. (Radiumthérapie des
** tumeurs malignes des organes génitaux de la femme.) Hygiea, 74 (1912), 445—450.

31. Översikt över resultaten av svulstbehandling vid Radiumhemmet i Stockholm 1910—1911. (Exposé des résultats obtenus à Radiumhemmet, Stockholm, en 1910—1911, dans le traitement des tumeurs.) Nord. Tskr. Ter. 11 (1912/13), 15—26.

38 a. Die Bedeutung der Röntgentherapie für die innere Medizin. Wien. klin. Wschr
** 27 (1914), 221—227.

38 b. Röntgenterapiens betydelse för den inre medicinen. Allm. sv. läkart. 1914, 115—120.

38 c. Nord. Tidsskrift for Terapi. 12 (1914), 129—145.
*

40. Om röntgenterapi vid Morbus Basedowii. (Sur la rœntgenthérapie du Morbus
** Basedowii.) Allm. sv. läkartidn. 11 (1914), 797—809.

41. Erfarenheter om radiumbehandling av underlivskräfta vid Radiumhemmet 1910
** —1913. (Expériences acquises à Radiumhemmet sur la radiumthérapie du cancer des organes génitaux de la femme 1910—1913.) Hygiea 76 (1914), 1170—1193, 1232—1244, 1294—1304, 1336—1343.

43. Bidrag till kännedomen om det filtrerade radiumljusets elektivt svulstförstörande
** verkan. (Sur l'effet électif du rayonnement filtré du radium sur les tumeurs.) Remarques au cours de la discussion. Sv. läk. sällsk. förh. 1915, 26—34.

44. Ett radiologiskt behandlat fall av sarkom å underkäken. (Un cas de sarcome de la mâchoire inférieure traité par radiation.) Sv. läk. sällsk. förh. 1915, 523—527.

45. Radiumbehandling. (Radiumthérapie.) Nord. familjebok, 2:a uppl., Bd 22, Sthlm
** 1915, col. 879—890.

49. Om indikationerna för radiumterapi vid kräfta. (Sur les indications de la radium-
** thérapie du cancer.) Nord. Tskr. Ter. 13 (1917/18), 129—154.

50 a. Übersicht über die Resultate der Krebsbehandlung am Radiumhemmet in Stock-
** holm 1910—1915. Fschr. Röntgenstr. 25 (1917/18), 142—149.

50 b. Översikt över resultaten av kräftbehandling vid Radiumhemmet i Stockholm 1910—1915. (Aperçu des résultats du traitement du cancer à Radiumhemmet, Stockholm, 1910—1915.) Allm. sv. läkartidn. 14 (1917), 357—366.

50 c. Översikt över resultaten av kräftbehandling vid Radiumhemmet 1910—1915.
** Tskr. Norske Laegeforen. 37 (1917), 269—279.

50 d. Översikt över resultaten av kräftbehandling vid Radiumhemmet i Stockholm
** 1910—1915. Hospitalstid. 1917, Nr. 12.

53 a. Röntgenterapien i den inre medicinen. (La rœntgenthérapie dans la médecine in-
* terne.) Lärobok i intern medicin, Bd 2: 2, Khvn 1918, 1306—1335.

53 b. Revu et corrigé ibidem, 2ème éd., Tome 4, 1921, 569—598.
*

54. Några erfarenheter om radiumbehandling vid läppkräfta. (Quelques expériences sur la radiumthérapie du cancer des lèvres.) Sv. tandläk. tskr. 11 (1918), 73—96.

64. Experiences in the radiological treatment of changes in the thyreoid gland. Remarques au cours de la discussion. Acta rad. 1 (1922), 509—510.

82. The permanency of the cure after radium treatment in skin cancer. Acta rad 3
* (1924), 253—254.

83. A porcelain applicator for superficial treatment with radium. Acta rad. 3 (1924), * 258—259.

84 a. Experiences in the permanency of radiological cure in cancer. Caldwell lecture. ** Amer. j. roentgenol. 12 (1924), 301—311.
84 b. Résumé dans Fschr. Röntgenstr. 33 (1925), 152—153. *

95. On radiotherapy applied to malignant tumours. Remarques au cours de la dis- * cussion. Acta rad. 8 (1927), 600—602.

96. On radiotherapy of cancer uteri. Remarques au cours de la discussion. Acta rad. * 8 (1927), 614—615.

97. (En collaboration avec O. Sandström.) Överblick över Radiumhemmets erfarenheter av röntgenbehandling vid Morbus Basedowii. (Exposé des expériences de Radiumhemmet sur la rœntgenthérapie du Morbus Basedowii.) Förhandl. Nord. kir. fören:s 16:e möte i Göteborg 1927, 42—60.

107 a. On the permanency of radiological healing in malignant tumors. Acta rad. Suppl. ** 2 (1928), 1—83.
107 b. Über die Beständigkeit der Radioheilung maligner Tumoren. Handbuch d. ges. Strahlenheilk., hrsg. v. P. Lazarus, Bd 2 (1929), 457—512.

130 a. Röntgen- och radiumbehandlingen vid kirurgiska sjukdomar. (La rœntgenthérapie et la radiumthérapie des maladies d'ordre chirurgical.) Nord. lärobok i kirurgi, Bd 1 (1932), 511—539.
130 b. Revu et corrigé ibidem, 2ème éd., 1940, 549—580. **

135. A critical analysis of radiotherapy in the treatment of malignant tumours. Canad. med. assoc. j., N. ser. 28 (1933), 30—35.

156. Roentgen treatment of pharyngeal and laryngeal cancer. Remarques au cours de * la discussion. Acta rad. 18 (1937), 520—522.

171. Strålskador. (Lésions causées par les rayons.) Nord. lärobok i kirurgi, 2:a uppl. * 1940, 201—203.

174. Den praeoperativa behandlingen vid cancer mammae. (Le traitement radiologique préopératif du cancer du sein.) Remarques au cours de la discussion. Nord. med. 8 (1940), 2739.

180. Kombinerad operation och strålbehandling av bröstkräfta. (Combinaison du traitement chirurgical et radiologique du cancer du sein.) Remarques au cours de la discussion. Nord. med. 12 (1941), 3435—3436.

III C. Électrothérapie

191. Om fulguration och röntgenbehandling vid hudkräfta. (Sur la fulguration et la * rœntgenthérapie du cancer de la peau.) Allm. sv. läkartidn. 5 (1908), 924—945 & 964—976.

192. (En collaboration avec J. Berg.) Fulgurationsbehandlingen av maligna svulster * enligt Dr. Keating-Hart. (La fulguration suivant le Dr. Keating-Hart pour le traitement des tumeurs malignes.) Sv. läk. sällsk. förh. 1908, 462—486.

21. Om de fysikaliska och biologiska grunderna för »fulgurationen» samt om de vid Serafimerlasarettet vunna erfarenheterna angående fulgurationsgnistans verkan på sjukligt förändrad vävnad utan kombination med kirurgiskt ingrepp. (Sur les bases physiques et physiologiques de la »fulguration» et sur les expériences acquises à l'Hôpital »Serafimerlasarettet» de Stockholm sur l'effet de l'étincelle de fulguration sur un tissu pathologiquement altéré sans combinaison avec une intervention chirurgicale.) Förhandl. Nord. kir. fören:s 8:e möte, Lund 1909, Avd. III, 3—64.

26. * Un cas de dilatation des capillaires sous-cutanés guéri par l'étincelle de haute fréquence. Arch. électr. méd. 18 (1910), 806—807.

IV. QUELQUES PROBLÈMES DE L'ENSEIGNEMENT ET DE L'ORGANISATION DES INSTITUTIONS RADIOLOGIQUES

IV A. L'enseignement de la radiologie médicale

88. * Teaching in medical radiology. Acta rad. 4 (1925), 638—639.

90. Undervisningen i medicinsk radiologi. (L'enseignement de la radiologie médicale.) Hygiea 88 (1926), 1—46, 73—111.

94. * Teaching in medical radiology. Main subject of the Second international congress of radiology. Acta rad. 8 (1927), 581—582.

109. Undervisningen och utbildningen i medicinsk radiologi särskilt med hänsyn till den i Sverige vunna erfarenheten. (L'enseignement de la radiologie médicale particulièrement au sujet des expériences acquises en Suède.) Med. fören. tskr. 6 (1928), 295—300.

115. ** Unterricht und Ausbildung in medizinischer Radiologie, mit besonderer Berücksichtigung der in Schweden gewonnenen Erfahrungen. Acta rad. Suppl. 4 (1930), 145—230.

151 a. The Mimi Althainz' chair of radiotherapy at the Royal Caroline Institute, Stockholm. Elis Berven the first professor. Acta rad. 17 (1936), 519—523.

151 b. Die Mimi-Althainz-Professur für Strahlentherapie am Kgl. Karolinischen Institut in Stockholm und ihr erster Inhaber Elis Berven. Strahlenther. 58 (1937), 490—494.

151 c. * — Fschr. Röntgenstr. 55 (1937), 620—622.

151 d. Mimi Althainz' professur i radioterapi vid Karolinska institutet. Elis Berven dess förste innehavare. Nord. med. tskr. 11 (1936), 1625—1628.

IV B. Quelques observations sur l'enseignement publique et sur quelques conditions vitales de l'enseignement clinique

5. ** Den svenska läkarutbildningens förbättrande genom en tids obligatorisk tjänstgöring som underläkare före legitimationens erhållande. (Amélioration de l'enseignement médical suédois par un service obligatoire d'interne avant de recevoir le diplôme.) Allm. sv. läkartidn. 4 (1907) 49—57.

57. Svenska sällskapet för medicinsk forskning. (L'Association suédoise pour les recherches médicales.) Sv. läk. sällsk. förh. 1919, 366—376.

125. Tal vid Norra Latinläroverkets femtioårsfest 1930. (Allocution au cinquantenaire
** du Lycée »Norra Latin» de Stockholm.) Redogörelse f. Högre latinlärov. å Norrmalm, läsåret 1930/1931, 10—12.

159. Iakttagelser angående studieresultatet för de medicinare, som under åren 1919—1927 tilldelats statens räntefria studielån. (Observations sur le résultat des études des étudiants en médecine ayant bénéficié des prêts consentis sans intérêt par l'État suédois pendant les années 1919—1927.) Med. fören. tskr. 1938. 210—217.

160. Anförande vid stiftandet av föreningen »Norra Latins sommarhem» 17. 3. 1938.
* (Allocution à la création de la Société la »Récréation d'été du Lycée Norra Latin».) Redogörelse f. Högre latinlärov. å Norrmalm, läsåret 1937/1938, 60—63.

170. Tillkomsten av »Norra Latins sommarhem». (L'origine de la »Récréation d'été» du Lycée »Norra Latin».) Röster om Norra Latins sommarhem. P. A. Norstedt & Söner, Sthlm 1939, 3—12.

178. Några erfarenheter och tankar om den kliniska forskningens och undervisningens livsbetingelser. Avskedsföreläsning d. 1. 3. 1941. (Quelques expériences et réflexions sur les conditions vitales pour les recherches et l'enseignement cliniques. Première conférence d'adieu, le 1er mars 1941.) Nord. med. 1941, 1673—1678.

178 bis. Avskedsord till studenterna efter avskedsföreläsningen d. 1 mars 1941 i Karo-
** linska sjukhusets aula. (Paroles d'adieu aux étudiants après la conférence d'adieu dans la salle des fêtes de l'Hôpital »Karolinska sjukhuset», le 1 mars, 1941.) Med. fören. tskr. 1941, 63.

IV C. Quelques problèmes organisateurs de la radiologie médicale

33. Das Telephon und das Diktaphon im Dienste der Röntgenologie. Z. Röntgenk. 14 (1912), 351—352. Voir II B.

85. Önskemål beträffande lasarettens röntgenavdelningar. (Desiderata des services rœntgenologiques des hôpitaux.) Sv:s landstings tskr. 1925, 276—278.

100 a. Utredning angående planläggning av den radiologiska sjukvården i Västernorrlands län. (Étude sur l'organisation du service médical radiologique dans le département de Västernorrland.) Sv. landstings tskr. 15 (1928), 1—15.
100 b. Västernorrlands läns landstings handl., 1929, 339—364.
*

151 a. The rôle of radiology in medicine. Radiology 30 (1938), 12—18.
151 b. Die Rolle der Radiologie in der Medizin. Fschr. Röntgenstr. 57 (1938), 1—17.
151 c. Radiologiens roll i medicinen. Nord. med. tskr. 15 (1938), 601—605.
**

190. Några ord om behovet av en fast organisation för behandlingskontroll vid sjukhusen. (Quelques mots sur la nécessité d'un contrôle ferme des résultats du traitement dans les hôpitaux.) Sv. sjukhusfören:s årsbok 1945, 61—65.

190 bis. Betydelsen av de kommunala sjukhusens utrustning för medicinsk forskning
* och läkareutbildning. (L'importance de l'équipement des hôpitaux municipaux pour la recherche et l'enseignement médicaux.) Diskussionsprotokoll vid Sv. Stadsförb:s sjukvårdsdelegations femte årssam. Stockholm, d. 27 juni, 1947, 27, Stencil.

V. CONSTRUCTION DES BATIMENTS CLINIQUES

V A. Les projets des bâtiments pour l'hôpital universitaire à Stockholm, »Karolinska sjukhuset», et de la construction de l'institut rœntgenologique de l'Hôpital »Serafimerlasarettet» à Stockholm

36. Serafimerlasarettets nya röntgeninstitut. Kort beskrivning av institutets lokaler och inredning. (Le nouvel Institut rœntgenologique de l'Hôpital »Serafimerlasarettet» à Stockholm. Brève description des locaux et de l'équipement de l'Institut.) Rapport för åren 1911 & 1912 från Kungl. Serafimerlasarettet, Stockholm 1913, p. xxiii—xxxix.

86. Serafimerlasarettets nybyggnadsfråga. Den radiologiska institutionen. (La question des nouveaux bâtiments de l'Hôpital »Serafimerlasarettet». L'institution radiologique.) Sv. läk. sällsk. förh. 1925, 395—401.

116. Karolinska institutets öde inför sitt avgörande. (Le sort de »Karolinska institutet» sur le point d'être décidé.) Socialmed. tskr. 7 (1930), 21—27, 43—54.

117. Avdelningarna för röntgendiagnostik och radioterapi vid Karolinska sjukhuset. (Les services de rœntgendiagnostic et de radiothérapie de l'Hôpital »Karolinska sjukhuset».) Socialmed. tskr. 7 (1930), 89—99.

127. (En collaboration avec E. Key & C. Westman.) Karolinska institutets byggnadsfråga. Erinringar med anledning av från Skattebetalarnas förening i skrivelse till statsutskottet av den 6 april 1932 framställd kritik mot Karolinska sjukhuset. (La question des bâtiments de »Karolinska institutet» à Stockholm.) Iduns tr., Stockholm 1932, 1—43.

128. (En collaboration avec E. Key & C. Westman.) Erinringar med anledning av arkitekten G. Birch-Lindgrens replik av den 30 april 1932 rörande Karolinska sjukhusets byggnadsfråga. (Remarques relatives à la réplique de l'architecte G. Birch-Lindgren au sujet de la question des bâtiments de l'Hôpital »Karolinska sjukhuset».) Iduns tr., Stockholm 1932, 1—6.

146. The radiology institutions of the »Karolinska sjukhuset». Acta rad. 16 (1935), 423—424.

172. Karolinska sjukhuset i Stockholm. (L'Hôpital »Karolinska sjukhuset» à Stockholm.) Nord. med. 6: 2 (1940), 1017—1028.

188. (En collaboration avec Th. Borell & E. Key.): Karolinska sjukhuset. Redogörel
* för första etappen av Karol. inst:s nybyggnader å Norrbacka vid Stockholm. (Description du premier développement des bâtiments de l'hôpital universitaire Stockholm, »Karolinska sjukhuset».) P. A. Norstedt & Söner, Sthlm, 1945, 1—26.

V B. Les projets des »Cliniques du Jubilé du Roi Gustave V»

99. Organisation und Arbeit im Radiumhemmet in Stockholm. Schweiz. med. Wschr. 9 (1928), 60—65.

106. Die radiotherapeutische Klinik des Kanzervereins in Stockholm, »Radiumhemmet», ihre Organisation, Arbeitsmethoden und Behandlungsresultate. Acta rad. 9 (1928), 315—363.

137. Beskrivning av byggnaderna för Konung Gustaf V:s Jubileumsklinik vid Karolinska sjukhuset. (Description des bâtiments de la Clinique du Jubilé du Roi Gustave V à »Karolinska sjukhuset» à Stockholm.) Meddelanden om Konung Gustaf V:s Jubileumsfond 1933—1934, 60—73, 96—106.

138. * Yttrande över byggnadsförslag för Jubileumskliniken i Lund 1934. (Rapport sur les projets des bâtiments de la Clinique du Jubilé du Roi Gustave V à l'Hôpital universitaire à Lund.) Meddelanden om Konung Gustaf V:s Jubileumsfond 1933—1934, 137—143.

165a. * The early history of the King Gustaf V's Stockholm Jubilee Clinic. Acta rad. Suppl. 38 (1939), 5—11.

165b. Jubileumsklinikens förhistoria. Konung Gustaf V:s jubileumsklinik i Sthlm 1938, 5—10.

166a. * The working and building program of the King Gustaf V's Stockholm Jubilee Clinic. Acta rad. Suppl. 38 (1939), 12—20.

166b. Jubileumsklinikens arbets- och byggnadsprogram. Konung Gustaf V:s jubileumsklinik i Stockholm 1938, 11—19.

167a. * A few recollections from the early history of the King Gustaf V's Stockholm Jubilee Clinic. Acta rad. Suppl. 38 (1939), 37—41.

167b. Några minnesbilder från förhistorien till Konung Gustav V:s Jubileumsklinik i Stockholm. Nord. med. 1: 1 (1939), 271—273.

VI. PUBLICATIONS DIVERSES

VI A. Biographies et nécrologies

4. * Philip Lenard. Hans betydelse för medicinen. (Philip Lenard. Son rôle dans la médecine.) Allm. sv. läkartidn. 2 (1905), 791—794.

16. * Bidrag till Dr Carl Flensburgs berättelse öfver Konung Oscar II:s sista sjukdom och död. (Contribution à la communication du Dr Carl Flensburg sur la dernière maladie et la mort de S. M. le Roi Oscar II.) Hygiea 1908, 689.

62. Heinrich Ernst Albers-Schönberg. In memoriam. Acta rad. 1 (1921), 129—131.

72. Erik Gottlieb Müller. Minnesord. (Nécrologie.) Hygiea 83 (1923), 657—674.

73. ** Wilhelm Conrad Röntgen. In memoriam. Acta rad. 2 (1923), 101—109.

74. * K. Sigfrid Ström. In memoriam. Acta rad. 2 (1923), 520.

87. Jean Bergonié. In memoriam. Acta rad. 4, (1925), 1—4.

91. Ivar Bagge. In memoriam. Acta rad. 5 (1926), 127—128.
**

92. Russell D. Carman. In memoriam. Acta rad. 5 (1926), 289—292.

93. Joseph Nachmanson. In memoriam. Acta rad. 8 (1927), 575—577.
**

104. Robert Knox. In memoriam. Acta rad. 9 (1928), 313—314.
**

105. Johannes Sjöberg. Minnesord vid Dr Johannes Sjöbergs grav. (Nécrologie.) Sancte
* Örjens Gilles dödsruna nr 14. 1928, 99—100.

120. M. Haudek. In memoriam. Acta rad. 12 (1931), 200.

121. Hugo Lauıell. Ein Überblick über sein bisheriges Werk. Acta rad. 12 (1931), 203—209.

122a. John Berg. In memoriam. Acta rad. 12 (1931), 413—415.
122b. John Berg. In memoriam. Nord. med. tskr. 3 (1931), 641—643.

123a. Guido Holzknecht. In memoriam. Acta rad. 12 (1931), 516—521.
123b. Guido Holzknecht. In memoriam. Hygiea. 93 (1931), 865—870.

133. Hermann Rieder. In memoriam. Acta rad. 14 (1933), 1—12.

143. Marie Curie. In memoriam. Acta rad. 15 (1934), 685—688.

150. Samuel Hybbinette 60 år. Nord. med. tskr. 11 nr 5. (1936).
**

151 a—d. The Mimi Althainz' chair of radiotherapy at the Royal Caroline Institute, Stockholm. Elis Berven the first professor. Acta rad. 17 (1936), 519—523 (*en allemand dans* Strahlenther. 58 (1937), 490—494 & Fschr. Röntgenstr. 55 (1937), 620—622, *en suédois dans* Nord. med. tskr. 11 (1936), 1625—1628. Voir IV A.

164. Antoine Béclère. In memoriam. Acta rad. 20 (1939), 521—536.

168. Anförande vid prof. A. W. Ahlbergs avsked från rektoratet vid »Norra Latin»
* 7. 6. 1939. (Allocution faite lors de la retraite de M. le professeur A. W. Ahlberg du provisorat du Lycée »Norra Latin» le 7. 6. 1939.) Redogörelse f. Högre allm. lärov. för gossar å Norrmalm, läsåret 1939/1940, 3—6.

175. S. A. Heyerdahl. In memoriam. Acta rad. 21 (1940), 622—632.

176. Anförande vid avtäckande av S. E. Henschens och H. C. Jacobæus' byster framför Serafimerlasarettets medicinska kliniker den 29 okt. 1940. (Allocution faite lors de l'inauguration des bustes de S. E. Henschen et de H. C. Jacobæus devant les cliniques de médecine interne de l'Hôpital »Serafimerlasarettet» le 29 octobre 1940.) Med. tskr. 1940, 257—259.

181. Erik Lysholm on his fiftieth birthday. Acta rad. 22 (1941), 535—538.

184. Konung Gustaf V och medicinen. (Le Roi Gustave V et la médecine.) Minnesskrif-ten »Vår konung» 1858 16/6 1943 utg. med anledning av H. M. Konung Gustafs 35-åriga regering och hans 85-årsdag. Lindfors, Sthlm 1943, 215—261. Voir III ..

186a. Adolf af Jochnick. In memoriam. Nord. med. 20 (1943), 1947.
186b. Adolf af Jochnick. Minnesord. (Nécrologie.) Ber. fr. Styr. f. Sv. sällsk. för me..
** forskning för år 1943. Tr. 1944, 4—8.

187. Hugo Laurell on his sixtieth birthday. Acta rad. 25 (1944), 385—398.

189. * Hälsning till Ernst Carlsen på 70-årsdagen. (Hommage à Ernst Carlsen à l'occasion de sa fête de 70 ans.) Festskr. för Ernst Carlsen 25. 5. 1945. Khvn 1945, 9.

191. Rolf Sievert on his fiftieth birthday. Acta rad. 27 (1946), 209—219.

194. Alban Köhler. In memoriam. Acta rad. 28 (1947), 105—109.

195. James Heyman on his 65th birthday. Acta rad. 28 (1947), 417—428.

197. Gunnlaugur Claessen. In memoriam. Acta rad. 31 (1949), 185—190.

VI B. Allocutions et communications diverses

10. * Berättelse över studieresa såsom innehavare av Anders Retzius-stipendiet för år 1908. (Rapport sur un voyage d'études fait par l'auteur en qualité de détenteur de la bourse Anders Retzius en 1908.) Sv. läk. sällsk. förh. 1908, 412—417.

48. ** Röntgenbehandling. Röntgenbild. Röntgendiagnostik. Röntgengenomlysning. Röntgenografi. Röntgenortodiagrafi. (Rœntgenthérapie. Rœntgenogramme. Rœntgendiagnostic. Rœntgenoscopie. Rœntgenographie. Rœntgenorthodiagraphie.) Nord. familjebok, 2:a uppl. Bd. 24, Sthlm 1916, col. 168—177.

61. Introduction and programme of the Acta radiologica. Acta rad. 1 (1921), 1—4.

71. ** Tal vid Stockholms första akademiska vårfest. (Allocution à la première fête printanière commune des étudiants des académies de Stockholm.) Ekonomen. 2 (1922), 13—14.

80. * Den medicinska radiologiens framtid. (L'avenir de la radiologie médicale.) Stockholms Dagbl. Jub. nr. 1924.

103. * A welcome to the Second International Congress of Radiology. Acta rad. 9 (1928), 209—212.

108a. ** Rede bei der Eröffnung des 2. Internationalen Radiologenkongresses in Stockholm am 24. Juli 1928. Acta rad. Suppl. 3: 1 (1928), 19—24.

108b. Tal vid öppnandet av 2:dra internationella radiologkongressen i Stockholm den 24 juli 1928. Sv. läkartidn. 25 (1928), 889—894.

118a. Röntgen- och radiumstrålarna i medicinens tjänst. Radioföredrag den 25 sept. 1929. (Les rayons rœntgen et de radium au service de la médecine. Conférence à la T. S. F.) Sv. Röda Korsets tskr. 22 (1930), 205—211.

118b. * Finlands Röda Kors 6 (1930), 157—163.

124a. Allocution en offrant le maillet présidentiel aux congrès internationaux de radiologie. Acta rad. 12 (1931), 596—597.

124b. * Rapports sur les questions à l'ordre du jour du III:e C. I. R. Paris, 1931, 58—63.

135 bis. * Hälsning från de nordiska ländernas medicinska sällskap vid Det Norske medicinske selskabs hundraårsjubileum d. 14 okt. 1933. (Hommage des Societés médicales des pays du Nord à la Société médicale norvégienne à l'occasion de sa fête séculaire.) Forh. i det Norske med. selskab 1933, 172 (särtr. s. 43—44).

145. Address in the Swedish society for medical radiology. Dec. 9, 1933. Acta rad. 16 (1935), 422.

147. Tal vid avtäckande av Rektor John Kjederqvists porträtt i Norra Latin. (Allo-
* cution faite lors de l'inauguration du portrait de John Kjederqvist, proviseur du Lycée »Norra Latin».) Redogörelse för H. latinläroverket å Norrmalm, läsåret 1934/1935, 1—2.

148. Tal vid Finska läkarsällskapets 100-årsfest 10—11 okt. 1935. (Allocution au centenaire de la Société finlandaise de médecine.) Finska läk. sällsk. hdl. 77 (1935), 799—801.

158. Tal vid medborgarhyllningen för H. M. Konung Gustaf V i Stadion den 16 juni 1938. (Discours prononcé à l'occasion de l'hommage national rendu à S. M. le Roi Gustave V au Stade de Stockholm le 16 juin 1938.) Stockholm 1938, 1—4.

182. Address at the opening of the 11th meeting of the North. assoc. for med. radiol. 14-6-1941. Acta rad. 23 (1942), 213—214.

183. Avskedsord vid avgången från Sophiahemmets röntgentjänst 17. 1. 1942. (Paroles
** d'adieu lors de la retraite de la place de rœntgenologue de l'Hôpital »Sophiahemmet».) Ber. över Sophiahemmets verksamhet under år 1941, 75—78. Sthlm 1942.

185. Ord vid invigningen av Med. föreningens sportstuga »Klippudden» 9. 5. 1943. (Allocution à l'inauguration de la maison de récréation »Klippudden» de la Société des étudiants de médecine.) Med. fören. tskr. 1943, 123—124.

196. Caligula, Ett minne från Stockholms nation, V. T. 1902. (Caligula. Un souvenir de la »Nation de Stockholm» de l'année 1902.) Stockholms nation trehundra år. Holmiana tredje häftet, Uppsala 1949, 107—108.

VI C. Analyse de certains risques dans l'assurance sur la vie

192. Översikt över Sv. livförsäkr. anst. Tryggs bedömningspraxis. (Aperçu des règles
* d'appréciation des risques de »Trygg», compagnie d'assurance sur la vie.) Stencil. 1945, 1—53. Fol.

193. Motivering till Sv. livförsäkr. anst. Tryggs bedömningspraxis. (Argumentation des
* règles d'appréciation des risques de »Trygg».) »Tryggs riskflora». Stencil 1945, 1—42. Fol.

VI D. Bibliographies

187 bis. Bibliography of Hugo Laurell. Acta rad. 25 (1944), 399—402. Voir VI A.

195 bis. Bibliography of James Heyman. Acta rad. 28 (1947), 429—432. Voir VI A.

197 bis. Bibliography of Gunnlaugur Claessen. Acta rad. 31 (1949), 191—192. Voir VI A.

198. Bibliographie de Gösta Forssell. Acta rad. 32 (1949), 337—358.

VI E. Collection d'extraits d'articles et de communications scientifiques

199. Tomes I—III, édités en 20 exemplaires numérotés, Stockholm, 1949.

VII. ACTIVITÉ ÉDITORIALE

Éditeur du périodique »Acta radiologica» depuis sa fondationen 1921. Vol. 1—31, 1921—1949.

Membre du Comité de rédaction de »Medicinskt Folkbibliotek», Stockholm, première édition, Vol. 1—30, 1924—1934.

VIII. ACTIVITÉ COMME MEMBRE DES COMITÉS OFFICIELS

Rapports et communications

Betänkande och förslag rörande användningen av Konung Gustaf V:s jubileumsfond, avgivet den 23 maj 1929 av den enligt Hans Maj:t Konungens beslut den 29 juni 1928 tillsatta kommittén. (Rapport et projet concernant l'utilisation du fonds du Jubilé de S. M. le Roi Gustave V, présentés le 23 mai 1929 par le Comité nommé le 29 juin 1928 suivant le décret du Roi.) P. A. Norstedt & Söner 1929.

Betänkande och förslag rörande uppförande av nytt kliniskt sjukhus i Stockholm m. m., avgivet den 24 oktober 1928 av den jämlikt Kungl. Maj:ts beslut d. 24 augusti 1926 tillsatta kommission. (Rapport et projet concernant la construction d'un nouvel hôpital clinique à Stockholm etc., présentés le 24 octobre 1928 par la Commission nommée le 24 août 1926 suivant le décret du Roi.) Statens offentliga utredningar 1928: 26.

Betänkande och överarbetat förslag rörande uppförande av Karolinska sjukhuset m. m. Avgivet av 1930 års sjukhuskommission. (Rapport et projet refondu concernant la construction de »Karolinska sjukhuset» etc., présentés par le Comité des hôpitaux de 1930.) Statens offentliga utredningar 1930: 34.

Betänkanden och förslag, avgivna av den kungliga kommission, som den 1 juni 1939 tillsattes för förhandlingar mellan kronan och Stockholms stad och län jämte ifrågakommande parter rörande fortsatt utbyggande av Karolinska sjukhuset m. m., beträffande följande avtal: (Rapports et projets, présentés par la Commission Royale, nommée le 1 juin 1939 pour négocier avec l'État, la ville et le département de Stockholm, et d'autres parties intéressées, en vue de poursuivre l'agrandissement de »Karolinska sjukhuset», etc., au sujet des conventions suivantes:)

d. 12. 8. 1940, angående uppförande av en pediatrisk och en dermatologisk klinik vid Karolinska sjukhuset samt om anordnande av en andra pediatrisk klinik vid ett nyuppfört stadens sjukhus i Stockholm m. m., preliminärt förslag. (Concernant la construction de deux cliniques pédiatriques et d'une clinique dermatologique.)

d. 7. 9. 1940, angående uppförande och drift av en pediatrisk och en dermatologisk klinik vid Karolinska sjukhuset. (Concernant la construction et l'exploitation d'une clinique pédiatrique et d'une clinique dermatologique à »Karolinska sjukhuset».)

d. 15. 9. 1944, angående uppförande och drift av en obstetrisk-gynekologisk klinik vid Sabbatsbergs sjukhus. (Concernant la construction et l'exploitation d'une clinique obstétrico-gynécologique à »Sabbatsbergs sjukhus».)

d. 14. 4. 1945, angående uppförande och drift av en medicinsk tuberkulosklinik och en thoraxkirurgisk klinik vid Karolinska sjukhuset. (Concernant la construction et l'exploitation d'une clinique médicale pour la tuberculose et d'une clinique pour la chirurgie thoracique à »Karolinska sjukhuset».)

d. 1. 12. 1947, angående upplåtande av Sabbatsbergs sjukhus för undervisningsändamål samt program för ett kliniskt sjukhus å Sabbatsberg, m. m. (Concernant la mise en disposition de »Sabbatsbergs sjukhus» pour l'enseignement et programme pour un hôpital clinique à Sabbatsberg, etc.)

RÉSUMÉ

Après une exposition des motifs et des desseins de la bibliographie et de sa nomenclature radiologique les œuvres du professeur GÖSTA FORSSELL, 1899—1949, sont présentées suivant les groupes des sujets traités.

SUMMARY

After introduction of motives and designs of the bibliography and of its radiological nomenclature the publications of professor GÖSTA FORSSELL, 1899—1949, are presented following the groups of subjects dealt with.

ZUSAMMENFASSUNG

Nach Bericht über Motive und Entwurf der Bibliographie und der radiologischen Nomenklatur derselben werden sämtliche Arbeiten von Professor GÖSTA FORSSELL, 1899—1949, in Gruppen von Fächern vorgelegt.